IJSRM
INTERNATIONAL JOURNAL OF SCIENCE AND RESEARCH METHODOLOGY
An Official Publication of Human Journals

Human Journals
Research Article
April 2020 Vol.:15, Issue:2

Evaluation of Microalbuminuria and Albumin Creatinine Ratio in Patients with Type 2 Diabetes Mellitus

IJSRM
INTERNATIONAL JOURNAL OF SCIENCE AND RESEARCH METHODOLOGY
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Submission: 22 March 2020
Accepted: 29 March 2020
Published: 30 April 2020

HUMAN JOURNALS
www.ijsrm.humanjournals.com

Keywords: Albumin creatinine ratio, diabetes mellitus, microalbuminuria

ABSTRACT

Background and objectives: Diabetes mellitus is a major endocrine disorder because of its global increase in prevalence rate. This study was conducted in type 2 diabetic patients to assess microalbuminuria, albumin creatinine ratio(ACR) and serum creatinine levels and compare it with normal controls. **Materials and Methods:** This study was a case control study which included 50 patients with type 2 diabetes mellitus (DM) and fifty healthy controls. Serum creatinine was estimated by modified Jaffes method. Microalbuminuria was estimated by the immunoturbidimetry method. Statistical analysis was done using SPSS. **Results and discussion:** Increase in mean level of serum creatinine, urine microalbuminuria, albumin creatinine ratio were observed among type 2 DM patients. A positive correlation was observed between microalbuminuria and urine ACR and between microalbumin and serum creatinine. A linear regression analysis showed a linear relationship between microalbumin and ACR among patients with Diabetes mellitus. **Conclusion:** We concluded that type 2 DM patients who are at risk of developing renal impairment must be regularly monitored for microalbuminuria and urine albumin creatinine ratio.

INTRODUCTION

Diabetes mellitus is a major endocrine disorder of the world because of its global increase in prevalence rate. Diabetes is found to be the major cause of End Stage Renal Disease (ESRD) in nearly 45% of patients who undergo dialysis.[1]

Type 2 diabetes mellitus is associated with significant morbidity and mortality mainly due to cardiovascular complications. Abnormal levels of urinary albumin excretion are seen in 30-40% of diabetics and is a commonest cause of end stage renal disease. Proteinuria is also an important marker of cardiovascular mortality in patients with Type 2 DM.[2]

The long-term deleterious effects of hyperglycemia on various end-organs necessitates regular monitoring of organ functions to initiate early intervention to prevent diabetes associated complications. The presence of trace amount of albumin in urine (microalbuminuria) has a good prognostic value in predicting early renal damage (initial nephropathy).[3]

Abnormal albumin levels in urine can be detected in 30 - 40% of patients diagnosed with type 2 DM.[4] Presence of protein in urine can subsequently lead to end-stage renal failure.[5]Albumin creatinine ratio in random urine samples is the most appropriate investigation to detect early renal impairment.[7]

The present study was conducted to evaluate microalbuminuria and albumin creatinine ratio as indicators for the early detection of renal impairment among diabetic patients and compare it with normal healthy controls.

OBJECTIVES

This study was carried out with the following objectives:

1. To evaluate the urinary levels of microalbumin ACR in patients with Type 2 Diabetes mellitus and compare it with normal controls.

2. To correlate microalbuminuria and ACR in patients with diabetes mellitus.

MATERIALS AND METHODS

This study was conducted in the Department of Biochemistry at Karpagam faculty of medical sciences and research. This study was approved by the Institutional Ethics Committee, Karpagam faculty of medical sciences and research, Coimbatore.

Study design: Hospital based case control study

Sample size: 100 (calculated by 4pq/d2; where p is prevalence)

Study group: 50 Patients with Type 2 Diabetes Mellitus and 50 healthy controls.

INCLUSION CRITERIA

Patients with Type 2 Diabetes mellitus attending diabetic clinic at Karpagam faculty of medical sciences and research, Coimbatore.

EXCLUSION CRITERIA:

Patients with **c**ardiovascular disorders (like CCF, H/o. CAD)**,** pulmonary disorders (like respiratory failure)**,** Infections (Urinary tract infection) & inflammatory states**,** febrile illness**,** cancers, Severe Renal impairment (eGFR< 30ml/min) and vigorous exercise.

Subjects who fulfilled the inclusion and exclusion criteria were included in the study. After explaining the nature of the study, written consent was obtained from all subjects before collecting blood sample.

Biochemical analysis

1. Estimation of serum Creatinine

Estimation of creatinine was done by modified Jaffe's method using ERBA- EM360 Automated analyser.

2. Estimation of microalbuminuria

Microalbuminuria was estimated by immune turbidimetry method using Hitachi 917 analyser.

3. Estimation of UACR

UACR was measured by $\frac{\text{Urine Albumin (mg/dl)}}{\text{Urine Creatinine (mg/dl)}} \times 1000$

Albumin is determined by using a probe (AB580) that specifically recognizes albumin (Ex/Em = 600/630 nm). Creatinine is converted to sarcosine via enzymatic reactions. Sarcosine is specifically oxidized generating a product that reacts with a probe producing a chromophore that can be detected at 570 nm.

Statistical analysis

Statistical Package for Social Sciences (SPSS, USA) was used to do the statistical analysis. All parameters were presented as mean ± standard deviation (mean ± SD). Student's t-test was used for comparing the means of continuous variables.

The correlations between various variables were calculated using the Pearsons correlation analysis. A linear regression analysis was performed to evaluate interrelationship between ACR and microalbuminuria. A p value of less than 0.05 was taken as statistically significant.

RESULTS

The mean concentration values of patients for plasma creatinine, microalbuminuria and albumin creatinine ratio were 1.67 mg/dl, 339.46 mg/L, and 3977.66 mg/g respectively in patients with diabetes mellitus.

Serum creatinine, microalbumin and ACR were significantly higher in DM patients when compared with controls (Table 1). Pearson's correlation analysis showed a positive correlation between microalbuminuria and urine albumin creatinine ratio ($r=0.888$, $P<0.001$) and also between microalbumin and serum creatinine ($r=0.842$, $P<0.001$) (Table 2).

A linear regression analysis showed a linear relationship between microalbumin and ACR among patients with Diabetes mellitus (Figure 1).

Table No. 1: Comparison of clinical parameters between diabetic group and control groups

Parameters	DIABETIC GROUP	CONTROL GROUP	P VALUE
Serum Creatinine (mg/dl)	1.67 ± 0.37	0.81 ± 0.15	0.001*
Microalbumin (mg/L)	339.46 ± 69.26	13.65 ± 3.82	0.001*
ACR (mg/g)	397.66 ± 131.68	6.64 ± 1.56	0.001*

Data are presented as Mean ±SD.*P value ≤0.05 is statistically significant. Student t-test was used to analyse the data. ACR=Albumin creatinine ratio,

Table No. 2: Correlation analysis of Microalbuminuria with ACR and serum creatinine in type 2 diabetic patients

Variables	R-value	P VALUE
ACR	0.888	0.001
Serum creatinine	0.842	0.001

Pearson correlation analysis was performed to analyze the data. * p<0.05 is considered statistically significant. ACR=Albumin creatinine ratio.

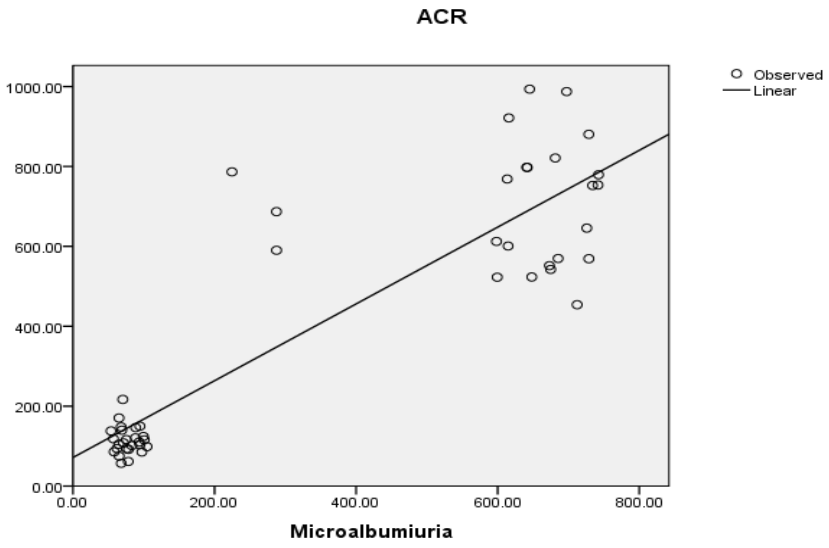

Figure No. 1: Linear regression analysis between Microalbuminuria and ACR among the diabetic cases

DISCUSSION

Diabetes mellitus is a heterogeneous group of multifactorial, polygenic syndrome characterized by an elevation of fasting blood glucose caused by a relative or absolute deficiency in insulin. [7]

The chronic complications of diabetes mellitus affect many organ systems and it is the major cause of morbidity and mortality in both type 1 and type 2 diabetes. The chronic complications are divided into macrovascular complications (coronary artery disease, peripheral arterial disease and stroke) and microvascular complications (diabetic nephropathy, neuropathy, and retinopathy).[1]

Since long-term hyperglycemia among diabetic patients can lead to permanent organ dysfunction including kidneys, regular monitoring of renal biomarkers is essential.[8,9]

Our study showed increased level of microalbuminuria and ACR in diabetic patients compared with the controls. Microalbuminuria was positively correlated with the serum creatinine and ACR which is consistent to a previous study.[10]We also observed that urine microalbuminuria and urine albumin creatinine ratio were sensitive and early indicators of renal impairment.

The risk factors for microalbuminuria are raised blood pressure and poor glycemic control. In microalbuminuria the Albumin Excretion Rate (AER) is 30 to 300mg/day. Microalbuminuria is the earliest indicator of diabetic kidney disease and generalised vascular endothelial dysfunction. In patients with known diabetes, microalbuminuria is related not only to subsequent diabetic proteinuria, but even more strongly to early death, mainly from cardiovascular disease.[11]

Diabetic patients with microalbuminuria should be carefully controlled in order to prevent or to decrease deterioration of renal function due to diabetic nephropathy. Hence screening should be done for the early detection of microalbuminuria and to prevent further renal damage in patients with diabetes mellitus.

CONCLUSION

The patients with type 2 DM who have a considerable risk factor for developing renal impairment should be regularly monitored for more sensitive biomarkers of nephropathy such

as microalbuminuria and urine albumin creatinine ratio for early detection of diabetes-induced nephropathy.

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