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Association of microalbuminuria with left ventricular dysfunction in type 2 diabetes mellitus

[1]Dr Anoopkumar Ah, Final Year Post-Graduate, Dept. of General Medicine, Kempegowda Institute of Medical Science, Bangalore-560070.

[2]Dr H. D. Ramachandra Prabhu, Professor, Dept. of General Medicine, Kempegowda Institute of Medical Science, Bangalore-560070.

Corresponding Author: Dr Anoopkumar Ah, Final Year Post-Graduate, Dept. of General Medicine, Kempegowda Institute of Medical Science, Bangalore-560070.

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Abstract

Introduction: Diabetes mellitus (DM) is associated with diverse cardiovascular conditions such as myocardial infarction, heart failure (HF), stroke and diabetic cardiomyopathy (DMCMP), which are the leading causes of diabetes-related morbidity and mortality. Albuminuria has been shown to predict cardiovascular (CV) morbidity and mortality in individuals with diabetes mellitus (DM). Microalbuminuria (MCA), a known marker of glomerular endothelial dysfunction, is also associated with microangiopathy in T2DM patients. It is suggested here that detection of MCA may also serve as an inexpensive pre-screening test for monitoring further deterioration in cardiac function in normotensive T2DM. In view of this, the present study was undertaken to study the association between microalbuminuria and Diastolic Dysfunction in Normotensive type 2 diabetes mellitus Patients

Materials: This cross-sectional study was performed 35 type 2 DM patients with normoalbuminuria and 35 type 2 diabetes patients with micro albuminuria admitted under the department of general medicine, Kempegowda institute of medical sciences during an 18-month period. All the patients underwent laboratory investigations including HbA1c, urine examination for microalbuminuria and 2D ECHO E/A Ratio (Diastolic Dysfunction).

Observation: The mean age of the study participants with microalbuminuria and normoalbuminuria were found to be 58.00±9.935 and 50.91±8.614 respectively. 55.7% of the study participants were males. The association was found to be statistically significant between microalbuminuria and left ventricular dysfunction (P<0.005).

Conclusion: The presence of microalbuminuria is associated with increased likelihood of LVDD in type 2

Diabetes patients. Increase in age and decrease in E/A ratio show direct and independent association with LVDD in normotensive diabetic patients with microalbuminuria. Therefore, diabetes patients who have microalbuminuria should be regularly (or more frequently) evaluated for development of LVDD using Echocardiography. This helps in early identification of myocardial diastolic dysfunction

Keywords: Type 2 Diabetes; Microalbuminuria; Left Ventricle; Diastolic Dysfunction

Introduction

Diabetes mellitus is a major public health problem globally and will be the world's seventh largest killer by 2030 [1]. Cardiovascular disease (CVD) is the leading cause of mortality in patients with type 2 diabetes mellitus (T2DM), accounting for 50.54% of cases [1]. Hyperglycemia is a risk factor for atherosclerosis and contributes to heart failure (HF) [2]. Some studies have shown that left ventricular hypertrophy (LVH) is present in up to 71% of patients with T2DM and is an early independent predictor of CVD [3, 4].

The urinary excretion of small amounts of albumin in the urine could be a serious predictor of future events, such as elevation of systemic arterial pressure, cardiovascular disease, and progressive renal dysfunction [6]. Urinary albumin excretion (UAE) has conventionally been divided into microalbuminuria and macroalbuminuria/ overt albuminuria. It is postulated that by being a marker of systemic endothelial dysfunction in type 2 DM patients, microalbuminuria may have a role as an early indicator of LVH [7]. In line with this, previous studies have shown a relationship between albuminuria and LV mass index and diastolic dysfunction [8, 9].

The most sensitive non-invasive test for detection of LV dysfunction is a two-dimensional echocardiogram [10]. Since left ventricular (LV) structure and function might be altered in type 2 diabetes even in the absence of cardiovascular disease, presence of coexistent microalbuminuria in DM may be an early marker of or contribute to more severe LV dysfunctions. Although some studies have found that albuminuria can increase the risk of LVH in T2DM patients with renal insufficiency [8, 11], another demonstrated that albuminuria was not significantly associated with the risk of LVH [12]. Currently, there is no consensus on whether albuminuria is related to LVH in diabetic patients, especially when renal function is not significantly impaired. In view of this, this study was undertaken.

Objective of the study

To Study the Association Between Microalbuminuria and Diastolic Dysfunction in Normotensive type 2 diabetes mellitus Patients

Methodology

Study Design: Prospective hospital-based study

Study Duration: 18 months (January 2021 - June 2022)

Study Area: Hassan institute of medical sciences, Hassan.

Study Participants: All female patients aged 16 - 45 years with a history of breast pain with or without tender nodularity attending the surgery OPD/IPD of Hassan institute of medical sciences, Hassan.

Inclusion Criteria

1. Patients who are more than 18 years with Type 2 Diabetes Mellitus

Exclusion Criteria

1. Patients with hypertension, type 1 diabetes mellitus, ischemic heart disease, heart failure secondary to valvular heart disease
2. Patient On steroids treatment
3. Patient with Cirrhosis of liver

Method Of Collection Of Data

70 patients with type 2 DM (35 with normoalbuminuria and 35 with micro albuminuria) attending the OPD/IPD of General medicine, KIMS Hospital, Bengaluru were included in the study. Clearance from the institutional ethical committee was taken before starting the study. Study participants were included in the study by Purposive Sampling technique.

Written informed consent was taken from the study participants before collecting the data. A pre-tested, semi-structured questionnaire was used to collect information on socio-demographic variables and clinical history related to diabetes by interview method. Relevant Laboratory and Radiological investigations were done. The investigations included FBS, PPBS, HbA1c, Urine for microalbuminuria and 2D ECHO E/A Ratio (Diastolic Dysfunction). Microalbuminuria was considered to be present when the two urine samples collected one month apart, produced a reaction colour corresponding to 20 mg/l or more. Based on this result the normoalbuminuria/ microalbuminuria status of the subject was determined.

Statistical Analysis

The data was collected and compiled in MS Excel. Descriptive statistics has been used to present the data. To analyse the data SPSS (Version 26.0) was used. Significance level was fixed as 5% ($\alpha = 0.05$). Qualitative variables are expressed as frequency and percentages and Quantitative variables are expressed as Mean and Standard Deviation. To compare the mean values between groups chi-square test was applied

Results

The mean age of the study participants with microalbuminuria and normoalbuminuria were found to be 58.00±9.935 and 50.91±8.614 respectively (Table 1). The gender of the study participants was found to be equal in both the groups without statistical significance (P=0.872) (Figure 1). The mean BMI of the study participants with microalbuminuria and normoalbuminuria were found to be 24.500±2.3135 and 23.686±1.6046 respectively. The mean duration of diabetes of the study participants with microalbuminuria and normoalbuminuria were found to be 8.17±3.792 and 5.57±3.042 years respectively. The mean Hba1c of the study participants with microalbuminuria and normoalbuminuria were found to be 9.931±1.7173 and 8.069±0.7779 respectively. The association was found to be statistically significant between Age, BMI, Duration of diabetes, Hba1c and the 2 groups of study participants (Table 1).

The mean E (cm/s) of the study participants with microalbuminuria and normoalbuminuria were found to be 65.34±2.071 and 79.71±3.392 respectively. The mean A (cm/s) of the study participants with microalbuminuria and normoalbuminuria were found to be 93.69±2.742 and 67.37±4.525 respectively. The mean E/A ratio of the study participants with microalbuminuria and normoalbuminuria were found to be 0.690±0.02 and 1.18±0.071 respectively. The mean EF (%) of the study participants with microalbuminuria and normoalbuminuria were found to be 51.00±3.47 and 53.43±2.71 respectively. The association was found to be statistically significant between microalbuminuria and left ventricular dysfunction (P<0.005) (Table 2).

Discussion

In the present study, the mean age of the study participants with microalbuminuria and normoalbuminuria were found to be 58.00±9.935 and 50.91±8.614 respectively. In a study done by Mehta J et al [13], majority of the study participants were in the age group of 51–60 years. In a study done by Kanwar BS et al [14], the mean age of study participants with normoalbuminuria and microalbuminuria was found to be 47.05 and 58.21 respectively.

The gender distribution of the study participants in the present study was found to be in accordance with the studies done by Mehta J et al [13] and by Kanwar BS et al [14], showing little male dominance.

In the present study, the mean BMI of the study participants with microalbuminuria was found to be higher than those with normoalbuminuria. Similar results were observed in the study done by Mehta J et al [13], Jørgensen PG et al [15] and Govind SC et al [16].

In the present study, the mean duration of diabetes of the study participants with microalbuminuria was found to be higher than those with normoalbuminuria. In a study done by Mehta J et al [13], majority of the study participants had duration of diabetes between 6–9 years in the microalbuminuria group compared to normoalbuminuria group. Also, in a study done by Kanwar BS et al [14], the mean duration of diabetes of the study participants with microalbuminuria was found to be higher than those with normoalbuminuria (11.66 vs 4.87).

In the present study, the mean Hba1c of the study participants with microalbuminuria was found to be higher than those with normoalbuminuria. In a study done by Mehta J et al [13], the mean Hba1c of microalbuminuric study participants was found to be higher than that of normoalbuminuric study participants with statistical significance. Similar results were found in the studies done by Kanwar BS et al [14], Jørgensen PG et al [15] and Govind SC et al [16].

In the present study, the mean E (cm/s) of the study participants with microalbuminuria was found to be lower than those with normoalbuminuria. The mean A (cm/s) of the study participants with microalbuminuria was found to be higher than those with normoalbuminuria. The mean E/A ratio of the study participants with microalbuminuria was found to be lower than those with normoalbuminuria. In a study done by Mehta J et al [13], the early (E) wave, and E/A ratio were significantly higher in normoalbuminuric patients compared to microalbuminuric patients. Whereas, atrial (A) wave was significantly lower in normoalbuminuric patients compared to microalbuminuric patients. In a study done by Kanwar BS et al [14], Albuminuria and LVH showed a statistically significant association (p value <0.01). In the study done by Jørgensen PG et al [15], impaired diastolic function was present in both patients with micro- and macroalbuminuria. Also, diastolic measures including e′, E/e′, and LA size were affected in patients with both micro- and macroalbuminuria. Govind SC et al [16], in their study found that the diabetic subjects had evidence of diastolic dysfunction at rest as measured by both conventional Doppler (transmitral E/A ratio, pulmonary venous systolic/diastolic ratio) and tissue Doppler (E′ velocity and E′/A′ ratio).

Nabbaale J et al [17] reported a positive correlation between microalbuminuria and LVH. Wu N et al [18] found that the risk of LVH in patients with microalbuminuria was significantly higher compared to non-diabetic patients. Nguyen MT [19] et al. reported

that microalbuminuria was predictive of LVH. Liu JE et al [8] found a higher prevalence of LVH (49%) in T2DM patients with macroalbuminuria compared to those with microalbuminuria. Guerra F et al [11] reported that patients with microalbuminuria had a 2-fold higher risk of LVMI. In the present study, we found a clear association between increased left ventricular dysfunction and albuminuria status (no albuminuria versus microalbuminuria) in T2DM patients.

Albuminuria is thought to be a marker of generalized vascular damage and impaired endothelial function [20, 21]. In the myocardium, the subendocardial layer, which is thought to be most sensitive myocardial layer due to the distance to the epicardial coronary arteries and because it undergoes high pressure variations throughout the cardiac cycle, is where the myocardial fibres mainly responsible for the longitudinal cardiac motion are found [22]. Thus, pathogenic mechanisms affecting the myocardium are thought to give rise to primarily longitudinal dysfunction in the early stages of the disease process.

These findings indicate that both the development of albuminuria and cardiac damage share a common background: as minor degrees of general vascular damage develop, the result is microalbuminuria and LV diastolic function. Thus, our study, supports the notion of vascular damage in association with albuminuria as a cause of heart failure in patients with T2D and suggests that renal protection strategies are important in the management of patients with T2D.

Conclusion

Our findings suggest that albuminuria status could be used as a surrogate marker for subclinical damage to assess the risk for CVS events. Clinicians should pay more attention to the prevention of renal and cardiac complications in patients with T2DM. Further studies with a larger sample size or clinical trials are needed to enhance the reliability of these results.

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Legend Figure and Tables

Figure 1: Gender of the study participants:

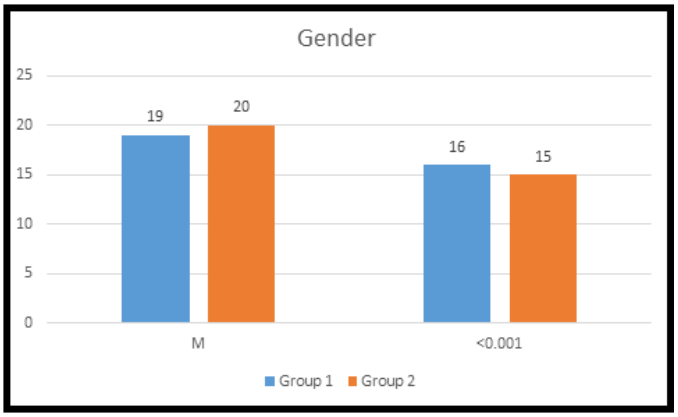

Table 1. General characteristics of the study participants.

Variables	Group 1	Group 2	P value
Age	58.00±9.935	50.91±8.614	0.002
BMI	24.500±2.3135	23.686±1.6046	0.092
Duration of DM (in years)	8.17±3.792	5.57±3.042	0.002
HbA1c	9.931±1.7173	8.069±0.7779	<0.001

Table 2. 2D-Echo parameters of the study participants.

2D-Echo parameters	Group 1	Group 2	P value
E (cm/s)	65.34±2.071	79.71±3.392	<0.001
A (cm/s)	93.69±2.742	67.37±4.525	<0.001
E/A ratio	0.6909±0.02582	1.1806±0.07182	<0.001
EF (in %)	51.00±3.473	53.43±2.715	0.002