Original Research Article

Association between Microalbuminuria and Hypertension in Type 2 Diabetic Patients

ABSTRACT

Aims: This study aimed to investigate the relationship between microalbuminuria (MAU) and hypertension in type 2 diabetic patients.
Study design: It was a descriptive type of cross-sectional study.
Place and Duration of Study: The study was conducted in Hypertension and Research Centre, Rangpur, Bangladesh from January to March 2018.
Methodology: A total of 180 diabetic patients were selected purposively age ranges 30-75 years from a outdoor based hypertension clinic. Anthropometric as well as biochemical measurement was done. Data was collected by a semi-structured questionnaire and analyzed by SPSS-20.
Results: Patients were divided into two groups. Group 1, those with normoalbuminuria (n=49) and Group 2, those having microalbuminuria (n=131). Group 2 patients showed higher blood pressure values (113.50±8.90mmHg) as compared to Group 1 (101.88±9.80mmHg). The results were statistically significant (*P* =<0.05) and showed poor glycemic control and high level of creatinine as contributing risk factor.
Conclusion: High prevalence of microalbuminuria was in type 2 diabetic outpatients with hypertension. Predictive factors for microalbuminuria were duration of hypertension, FBS, systolic blood pressure, sCreatinine and the presence of neuropathy. This study emphasizes the necessity to screen for microalbuminuria early and the active management of modifiable risk factors to reduce the burden of cardiovascular diseases in the future.

Keywords: Normoalbuminuria, Microalbuminuria, Macroalbuminuria, Hypertension, type 2 diabetes Mellitus

1. INTRODUCTION

A worldwide public health problem is diabetes mellitus (DM) especially type 2 diabetes mellitus (T2DM). In recent year T2DM and hypertension are two important public health challenges, and both are linked to increased risk of cardiovascular events [1]. In the diabetic individual hypertension markedly increases the risk and precipitates the course of cardiac disease, peripheral vascular disease, stroke, retinopathy, and nephropathy [2].In most of the T2DM patients may be hypertensive for years preceding to the onset of overt diabetes. About 70-80% patients have hypertension at the time of diagnosis of T2DM. Still blood pressure rises further in those patients who subsequently develop diabetic nephropathy [3].

Diabetic nephropathy is an important cause of end stage renal disease (ESRD) worldwide [4]. It also responsible for a third of all patients requiring renal replacement therapies, The most important causes for the development of diabetic nephropathy are progressive increase in the excretion of protein, particularly albumin, an early and continuing rise in systolic blood pressure, and a late decline in glomerular filtration rate, leading eventually to end stage renal failure. Systolic blood pressure may be particularly important and in the UKPDS (United Kingdom Prospective Diabetes Study), higher blood pressure was associated with a higher risk of macro vascular and micro vascular disease [5]. Hypertension and Microalbuminuria commonly coexist. The mechanism is still controversial. But it is thought to be a renal manifestation of generalized vascular endothelial dysfunction and strongly linked with increased cardiovascular risk. It is well appreciated both that coexisting hypertension exacerbates diabetic nephropathy and that diabetic nephropathy somehow results in a markedly increased risk of hypertension [6]. Microalbuminuria is a marker of the increase of cardiovascular disease [7]. In addition to, microalbuminuria is the first clinical detectable sign of DN and is considered as an independent predictor of diabetic nephropathy [8]. National Kidney Foundations (NKF), defines microalbuminuria as excretion of 30-300 mg of albumin in a 24 hour urine collection sample (equivalent to albumin creatinine ratio (ACR) 30- 300 mg/g without regard to age & sex in a random or spot sample of urine), on the other hand with values >300 mg/24 hour being defined as macroalbuminuria (equivalent to (ACR) > 300mg/g without regard to age & and sex in a random or spot sample of urine [9]. Microalbuminuria is also characterized by increased prevalence of arterial hypertension, proliferative retinopathy, and peripheral neuropathy [10]. In type-2 diabetes mellitus prevalence of microalbuminuria ranges from 8-47%[11],[12]. Studies in the Western literature have documented the linear relationship of degree of microalbuminuria with body mass index (BMI), blood pressure, and duration of diabetes. Gender correlation of microalbuminuria was not seen in type-2 diabetes mellitus [10],[13].

According to the American Diabetes Association patients with T2DM are tested for albuminuria at the time of preliminary diabetes diagnosis and yearly afterward [14]. The earliest stage of renal damage and aggressively controlling blood pressure screen is so much important. It can help to prevent more severe renal involvement. Blood pressure control is at least as important as glucose control, especially after the onset of renal damage [15]. The present study was aimed to determine the prevalence of microalbuminuria in T2DM patients as well as to see the correlation between microalbuminuria and hypertension in those diabetics and its association with other risk factors.

2. MATERIAL AND METHODS

2.1 Place of the study

The study was conducted in Hypertension and research Centre (HTRC), Rangpur, northern Bangladesh.

2.2Study population

Patients with type-2 diabetes mellitus of duration four years or more attending the HTRC (only outdoor based healthcare centre) were included in this study. The inclusion criteria of the study subjects were: a) Adult subjects (male and female) aged 30-75 years. b) Subjects with both abnormal and normal blood glucose level. c) Subjects voluntarily agreed to participate in the study and d) Subjects who have history of Diabetes mellitus and Hypertension. Diabetic patients suffering from any other medical problem like chronic heart disease, renal and liver diseases such as history of ischemic heart disease; history of renal disease or disturbed BUN creatinine; history of liver disease such as hepatitis B or C positive or disturbed liver function tests were excluded from the study.

2.3Study design

This cross-sectional descriptive study was carried out between January 2018 and March 2018 to investigate the correlation between microalbuminuria and hypertension among T2DM patients.

2.4Sample size and Sampling technique

2.4.1Sample size determination

Sample size was determined by using following formula:

$n=z^2pq/d^2$

Here, n=sample size

z=standard normal deviaton, the value is 1.96 at 95% confidence level

p= Estimated prevalence rate of micralbumnuria was 41.0% [16].

p=0.41

q= Estimated non-prevalence rate was 59.0%

= 1-p

=1-0.41=0.59

d=degrees of precision or allowable error. Here we set it at 5%

d=5% =0.05

So, our sample size, $n = \frac{z^2 \times p \times q}{d^2} = (1.96^2 \times 0.41 \times 0.59)/0.05^2$

$=371.71 \cong 372$

However, due to time and resources constraint, a sample of size 180 type 2 diabetic patients was enrolled in the study. The sample selection of this study was purposive.

2.5 Study design

This cross-sectional descriptive study was carried out between January 2018 and March 2018 to investigate the correlation between microalbuminuria and hypertension among T2DM patients.

2.6 Measurement

Blood pressure, smoking habit were recorded for each patient. BMI was calculated as weight (Kg) divided by height (m^2). Blood pressure was measured using Barometric Sphygmomanometer. Blood pressure was measured in sitting position, with calf at the level of the heart. After 10 minutes of rest a second reading was taken and average was recorded. Recorded Korotkoff sound I (the first sound) and V (the disappearance of sound) denoted the systolic blood pressure (SBP) and diastolic blood pressure (DBP), respectively (According to WHO-IHS). Mean arterial pressure (MAP) was calculated as systolic + (2xdiastolic) pressure.

High blood pressure was defined as systolic blood pressure (SBP) ≥140mm(Hg) and diastolic blood pressure (DBP) of ≥90mm(Hg) or use of anti-hypertensive medications.[7] Blood samples were obtained for test of serum glucose, serum creatinine. All assays were performed according to the guideline of the manufacturers. Serum glucose was measured by enzymatic colorimetric (GOD-POD) method in the Humalyzer 3000. Estimation of creatinine was done by modified Jaffe method in the humalyzer 3000 using reagents Randox CREA R1a and R1b.

Morning urine sample was used to calculate micro albumin: creatinine ratio in mg/g. Micro albumin was carried out using ELISA assay developed at NHRC and validated at NETRIA UK, whereas creatinine was done by calorimetric methods using Fortress kit USA. If the ratio was <30mg/g the patient was normoalbuminuric, ratios between 30-300mg/g were indicative of microalbuminuria and above 300mg/g revealed macroalbuminuria. Subjects were excluded from the study if they came to the clinic after vigorous exercise.

2.7 Data collection tool

A semi-structured questionnaire was used as a data collection tools regarding the demographic data such as age, gender, height, body weight while wearing light weight clothing, without shoes and family history of DM and collected through face to face interviewing technique.

2.8 Statistical analysis

Data were analyzed using SPSS-20 (Chicago, IL, USA). Results are presented as mean ± standard deviation (SD) for continuous variables, and as frequencies and percentages or proportions for categorical variables; *t*-test was used for continuous variables and chi square test for categorical variables. The distribution of variables was assessed by examining the frequency, bar and column diagram. The Pearson correlation coefficient (r) was used to measure the strength. A *P*-value of 0.05 or less than 0.05 was used as a level of significance with a 95% confidence level.

2.9 Ethical issues

Study was approved by the institutional ethics committee and written informed consent was taken from all the patients.

3. RESULTS

Prevalence of Microalbuminuria among study subjects

Out of 180 DM patients 27.2% (49) and 72.8 %(131) were normoalbuminuric and microalbuminuric respectively.

Table 1.Prevalence of Microalbuminuria among study subjects

Albuminuria Status	Frequency	Proportion (%)
Normoalbuminuric(<30mg/g)	49	27.2
Microalbuminuric (30-300mg/g)	131	72.8

Patients were divided into two Group 1 or Normalbuminuric: (n=49) were those patients with micro albumin: creatinine ratio <30 mg/g and Group 2 or Microalbuminuric: (n=131) were those patients with micro albumin: creatinine ratio between 30-300 mg/g for comparison.

Baseline Characteristics of Group 1 and Group 2

A total of 180 patients, 79 males and 101 females, were included in the study. In group 1, 27.1% and in group 2, 72.9% had positive history of DM. There was no significant statistical difference in case of age (Group 1:55.71±9.58; Group 2: 54.31±8.83), BMI (Group 1: 23.38±3.79 kg/m²; Group 2: 24.14±3.68 kg/m²), and age at onset of DM (Group 1: 47.62±10.07; Group 2: 47.05±9.03) between two groups (Table-2). Mean FBS in group 1 7.37±3.37 (mmol/L) was while in group 2 it was 9.9±2.71 (mmol/L). These results were statistically significant (Table-2). Mean sCreatinine in group was 1.03±0.37 (mg/dl) while in group 2 it was 1.98±0.44 (mg/dl). These results were statistically significant (Table-2).

Table 2.Baseline Characteristics of two groups:

Variables	Group 1	Group 2	*P*-value
Sex(n=180)			
Male=79	20(25.3%)	59(74.7%)	-
Female=101	29(28.7%)	72(71.3%)	
Age in years	55.71±9.58	54.31±8.83	0.356
BMI in kg/m²	23.38±3.79	24.14±3.68	0.224
Age at onset of DM in years	47.62±10.07	47.05±9.03	0.626
FBS(mmol/L)	7.37±3.37	9.9±2.71	0.001
sCreatinine(mg/dl)	1.03±0.37	1.98±0.44	0.03
Family History of DM			
Yes	9(27.1%)	51(72.9%)	
No	30(27.3%)	80(72.7%)	-

v alues were expressed as Mean±SD except sex and family history of DM; Independent T-test.
: Fasting Blood Sugar, DM: Diabetes Mellitus; *P*≤0.05 was considered statistically significant.

The two groups were also assessed for difference of blood pressure that included systolic (SBP), diastolic (DBP) and mean arterial pressure (MAP). Group 2 showed mean systolic pressure (MSP) higher than group 1 as evidenced by $P<0.05$ that was statistically significant. Similarly group 2 showed mean diastolic pressure (MDP) and mean arterial pressure (MAP) higher than group 1 as evidenced by $P<0.05$ that is again statistically significant. These results showed significant statistical difference (p value=<.05). So, microalbuminuric (Group 2) had higher blood pressure values as compared to normoalbuminuric patients (Group 1)[Table 3].

Table 3.Difference of Blood Pressure between two Groups

Variables	Group 1	Group 2	*P*-value
Systolic Blood Pressure	123.57±14.21	141.30±15.56	0.008
Diastolic Blood Pressure	82.65±5.41	89.16±7.52	0.022
Mean Blood Pressure	101.88±9.80	113.50±8.90	0.030

values were expressed as Mean±SD; Independent T-test; $P \leq 0.05$ was considered statistically significant.

4. DISCUSSION

The incidence of diabetes mellitus is significantly rising in last few decades [17]. This current global epidemic is associated with an increase of cardiovascular diseases that primarily accounts for the increase in morbidity and mortality seen in patients with diabetes [18],[19]. This cross-sectional study presents data on prevalence and associations of microalbuminuria with various parameters in type-2 diabetes mellitus. Present study has shown prevalence of microalbuminuria at 72.8%, which is much higher when compared to the study by Ghai et al. where prevalence was reported at 25% [20]. Higher prevalence in the present study may be due to the fact that most of the patients were on irregular treatment with poor glycemic control and also may be due to the small sample size. Method of estimation of microalbuminuria as well as ethnical differences would have also played a role in giving higher prevalence in the present study. The level of glycemic control seems to be the strongest factor influencing transition from normoalbuminuria to microalbuminuria [21].

A well-known United Kingdom (UKPDS) prospective diabetes study on diabetes mellitus reported that the presence of hypertension is a risk factor for microalbuminuria and retinopathy and that reducing the incidence of chronic complications was significantly associated with the amplitude of systolic blood pressure decrease, the lowest risk corresponding to a systolic blood pressure below 120mm(Hg) [5] which was also support our study.

The risk factors associated with microalbuminuria were found to be poor glycemic control and hypertension. It is now widely appreciated that the emission of even small amounts of albumin in the urine may portend serious future events, such as elevation of systemic arterial pressure, cardiovascular disease and progressive renal dysfunction [22],[23]. In general microalbuminuria is a susceptible marker for damage induced by diabetes [24].

5. CONCLUSION

High prevalence of microalbuminuria was in type 2 diabetic outpatients with hypertension. Predictive factors for microalbuminuria were duration of hypertension, FBS, systolic blood pressure, sCreatinine and the presence of neuropathy. This study emphasizes the necessity to screen for microalbuminuria early and the active management of modifiable risk factors to reduce the burden of cardiovascular diseases in the future.

CONSENT

All authors declared that 'written informed consent' was obtained from the patient (or other approved parties) for publication of this research article. A copy of the written consent is available for review by the Editorial Board members of this journal.

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