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Original Research Article

Association of microalbuminuria with severity of coronary artery disease in diabetic patients: a cross-sectional study

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ABSTRACT

Background: Microalbuminuria is recognized as a significant indicator of early cardiovascular problems and diabetic renal impairment. It is indicative of vascular and endothelial damage and could be predictive of coronary atherosclerosis. The purpose of this investigation is to stratify coronary angiographic features in individuals having type 2 diabetes mellitus (T2DM), microalbuminuria and suspected of suffering from ischemic heart disease.
Methods: The cross-sectional prospective study had been performed over two years. Individuals who had T2DM undergoing coronary angiography for suspected ischemic heart disease but no prior history of myocardial infarction were chosen for the investigation.
Results: The investigation involved coronary angiography for 77 individuals with T2DM suspected of suffering from ischemic heart disease. 61 (79%) of the 77 individuals had normoalbuminuria, and 16 (21%) had microalbuminuria. Six individuals with normal coronary arteries were in normoalbuminuria group, while none in the microalbuminuria group had normal coronary arteries, as determined by angiography. All diabetic patients exhibiting microalbuminuria had multiple coronary artery diseases (CAD), which is indicative of a severe condition.
Conclusions: Microalbuminuria has been demonstrated to predict a more severe form of CAD along with intricate and widespread coronary lesions in people suffering from T2DM. Chronic smokers and elderly people having T2DM are more affected. Microalbuminuria has been associated with a severe form of coronary disease in these individuals. It was discovered that individuals with microalbuminuria were prone to more severe diffuse illness, and many had smaller caliber arteries that would be difficult to revascularize.

Keywords: Coronary artery disease, Diabetes mellitus, Microalbuminuria

INTRODUCTION

Crucial independent risk factor pertaining to coronary heart disease is diabetes mellitus (DM).[1] Due to accelerated atherosclerosis, which develops more quickly in those with diabetes than in those without it, coronary heart disease is prevalent in people having DM.[2] Diabetes has been associated with a 2–5-fold rise in coronary heart disease as well as cardiovascular disease (CVD)-related mortality, according to multivariate analysis using major prospective investigations encompassing Framingham study, multiple risk factor intervention trial" (MRFIT),[3] as well as Nurse Health Study.[4]

In diabetic individuals, heart disease is a leading cause of morbidity as well as death.[5] Atherosclerosis-related macrovascular disease is most likely accountable for this. However, the mechanisms underlying CAD in certain diabetics are similar to those of nephropathy (microvascular disease), which affects the kidneys.

Microalbuminuria is commonly recognized as a significant indicator of both early vascular problems and diabetic

renal impairment. Presence of dipstick-positive proteinuria is a sign of diabetic renal disease. Future diabetic renal disease development has been predicted by microalbuminuria. Additionally, among diabetics, it is closely related to coronary heart disease as well as cardiovascular risk.[6] Microalbuminuria has been associated with higher all-cause cardiac mortality, cerebrovascular disorders, cardiac abnormalities, as well as peripheral vascular disease, according to epidemiological and other evidence.

Even when microalbuminuria levels are lower, adverse clinical consequences of CVD have been documented.[7,8] Cardiovascular risk was elevated in heart outcomes prevention evaluation (HOPE) research when microalbuminuria was present. All-cause death rate was 9.4% for individuals without normal albuminuria and 18.2% for those with microalbuminuria. Even with values significantly below the normal urine microalbumin levels, a linear connection between cardiovascular events and microalbuminuria patients was seen. Microalbuminuria raised the risk of cardiovascular death in a different prospective trial with participants aged 50-75.[9]

Individuals with microalbuminuria had a higher overall mortality rate, particularly those who also had concomitant hypertension. Relationship between microalbuminuria as well as severity of coronary disease is not well documented in the literature. Thus, this investigation assessed the relationship between CAD and microalbuminuria among individuals having T2DM.

METHODS

Source of data

This is a cross-sectional study. Individuals who meet inclusion as well as exclusion criteria and have been admitted for coronary angiography between December 2022 and November 2024 to Department of Cardiology at Raja Rajeshwari Medical College and Hospital.

Selection of study subjects

Inclusion criteria

Patients were included who had DM (individuals were diagnosed with DM based on WHO criteria), patients with suspected ischemic heart disease and with an age of 40 years or more. Patients, both male and female, were considered for this study.

Exclusion criteria

Patients not willing for angiography were excluded along with patients having history of underlying renal disease, patients who had macroalbuminuria, patients exhibiting elevated serum creatinine >2 mg/dl, patients having active urinary tract infection, patients demonstrating history of malignancy, and patients having history of prior myocardial infarction.

Methodology

Anthropometric data, encompassing weight, height, as well as waist circumference, had been recorded on a semi-structured proforma along with a thorough and relevant medical history. The blood pressure of the right upper limb was measured while the subject was seated.

Hypertension was defined as systolic blood pressure over or equal to 140 mmHg and/diastolic blood pressure over or equal to 90 mmHg, or active usage of any antihypertensive drugs.

Following an eight-hour fast, blood was taken in one sitting for the thyroid assay, lipid profile, and fasting blood sugar and serum creatinine.

Albumin and creatinine were measured in a single urine specimen. Diagnostic kit (Diyazim) was used to measure creatinine (Jaffe method) and albumin (bromocresol green method). The apparatus was Alcyon, 3001 and auto-analyser system.

Coronary angiography (assessment for coronary artery atherosclerotic disease)

The diagnostic procedure was performed by an experienced interventional cardiologist using a Siemens Artis Zee Cath-lab system after administering local anaesthesia. Angiography was done in several views in order to grade various lesions properly.

Assessment of the severity of coronary artery disease was done qualitatively and quantitively by the interventional cardiologist using the Cath-Lab system.

SYNTAX score was calculated using the online SYNTAX score calculator at www.syntaxscore.com

Statistical analysis

Data were statistically described in terms of mean, standard deviation (SD) for quantitative and frequencies and percentages (prevalence) for qualitative variables. Comparison between the study groups was done using independent t-test and Mann Whitney U-test for numerical, Chi-square and Fisher's exact test for categorical data variables.

Correlation between two numerical various variables was done using Pearson correlation coefficient (Spearman rank correlation equation for non-normal variables).

P values less than 0.05 were considered statistically significant. Statistical calculations were done using statistical package for the social sciences (SPSS).

RESULTS

In this investigation, coronary angiography was performed on 77 individuals suffering from T2DM who were suspected of suffering from ischemic heart disease at Raja Rajarajeswari Medical College and Hospital Department of Cardiology between December 2022 and November 2024. Of these, 43 (56%) were men and 34 (44%) were women.

Of the 77 individuals, 61 (79%) had normoalbuminuria, and 16 (21%) had microalbuminuria. Of the sixteen individuals with microalbuminuria, four were female, and twelve were male. Significant differences in prevalence of microalbuminuria among two groups had been observed.

Odds ratio M/F 5.3; 95% CI:1.53-18.5; p value <0.005.

Among 61 individuals having normoalbuminuria, 39 were male, while 22 were female.

Normoalbuminuria group's average age was 59.4 years, ranging from 44 to 72 years. The p value was over 0.05, and the standard deviation was 6.81, indicating that the data wasn't statistically significant. Average age of microalbuminuria group was 60.4 years, with a range of 51 to 72 years. P values greater than 0.5 were not statistically significant; the standard deviation was 2.42. However, a comparison of 2 groups revealed statistical significance, exhibiting standard deviation of 0.707, along with a p value <0.04.

The study population's age distribution is given in Table 1 and Figure 1.

Table 1: Age distribution of study population.

Age (years)	Normoalbumi-nuria, n=61	%	Microalbumi-nuria, n=16	%
41-50	6	7	0	
51-60	27	35	6	7
61-70	26	33	10	13
>70	2	2	0	

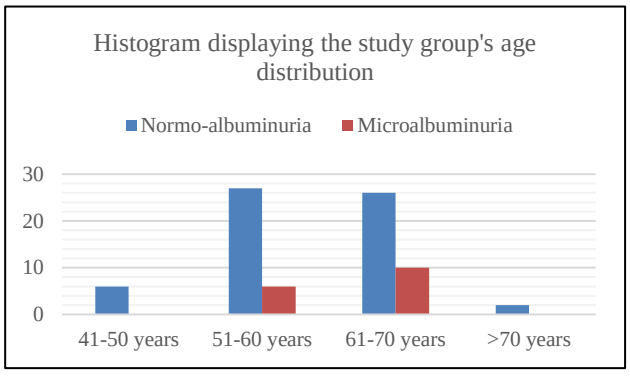

Figure 1: Histogram displaying the study group's age distribution.

Out of 61 individuals within normoalbuminuria group, 30 exhibited systemic hypertension and were receiving antihypertensive drugs. Hypertension has been observed in 11 out of 16 patients with microalbuminuria.

While the diastolic blood pressure ranged from 70 to 106 mmHg, the average DBP was observed to be 85.24 mmHg, and average SBP was 136.5 mmHg, with a range of 110 to 176 mmHg.

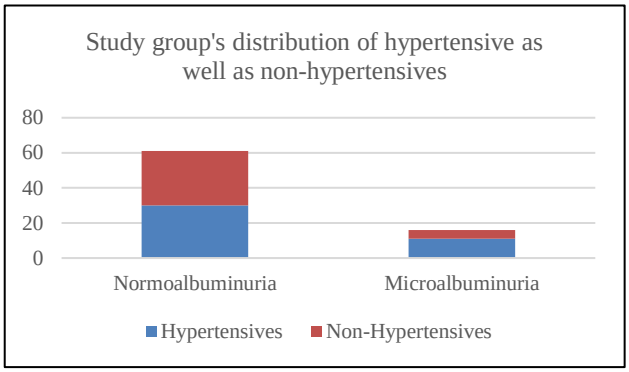

Figure 2: Study group's distribution of hypertension as well as non-hypertension.

DM ranges in length from 4 to 12 years. Every individual used oral hypoglycemic drugs. Of the 61 individuals (44%) in the normoalbuminuria group, 27 lacked proper blood sugar management at the start of the trial. During the study period, 8 out of 16 individuals (50%) with microalbuminuria lacked proper glycemic control. Both the normoalbuminuric and microalbuminuric groups had mean fasting blood sugar levels of 105.3 and 106.5 mg/dl, respectively. In the normoalbunuric group, the mean HDL cholesterol level was 38.22 mg/dl, with variations within 32-44 mg/dl. The mean result in the microalbuminuric group was 36.12 mg/dl, within 30-40 mg/dl. A p value of 0.025 (<0.05) indicated statistical significance when the two data were compared employing paired t-test for means. In normoalbuminuric group, LDL cholesterol ranged from 122-172 mg/dl, with a mean of 148.93 mg/dl; in microalbuminuric group, it ranged from 144-174 mg/dl, with a mean of 157.75 mg/dl. 2 averages had no statistically significant difference, with p value >0.5.

Triglycerides varied from 142-210 mg/dl with an average of 161.39 mg/dl in the normoalbuminuric group and from 146-210mg/dl with an average of 165.62 mg/dl in microalbuminuric group. Statistically insignificant difference among two values; p value was 0.5.

The study population's female group did not include any smokers. However, 30 out of 61 patients (49%) who were males in the normoalbuminuria group were smokers, either presently smoking or had previously smoked. Eight of the sixteen individuals in the microalbuminuria group smoked.

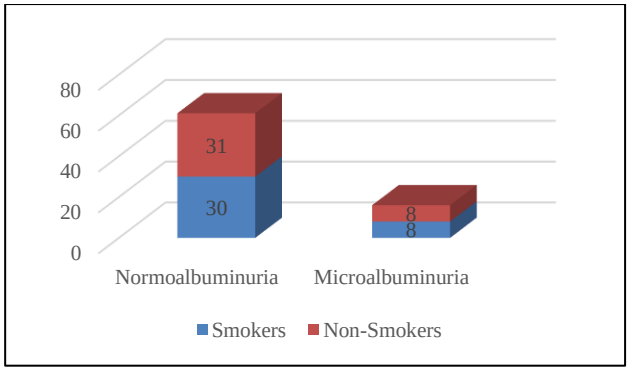

Figure 3: Smokers in the study group.

Smokers in study group

The normoalbuminuric and microalbuminuric groups' coronary angiographic profiles were compared.

Six individuals in the normoalbuminuric group had normal coronary angiography, while none of the individuals in the microalbuminuric group did.

Twelve individuals with one vessel disease were in the normoalbuminuric group, while none of the microalbuminuric group had one. Two-vessel disease had been observed in four of microalbuminuria group as well as twenty-four of normoalbuminuria group. Twelve individuals with microalbuminuria and 19 individuals with normoalbuminuria and 19 individuals with normoalbuminuria had three-vessel disease. Six individuals with microalbuminuria and eight individuals with normoalbuminuria had diffuse disease with narrow arteries that made them unsuitable for CABG.

Chi-square 5.066; p value 0.05; difference among 2 groups has been statistically significant.

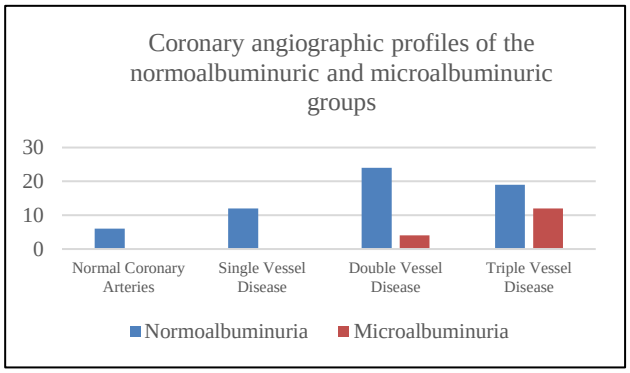

Figure 4: Coronary angiographic profiles of the normoalbuminuric and microalbuminuric groups.

The SYNTAX score has been used to categorize study group's coronary angiographic profile based on its severity.

Ten patients in group with normoalbuminuria exhibited syntax scores below 22, while none of individuals in the group with microalbuminuria did.

The syntax scores of four individuals in microalbuminuria group as well as twenty-six individuals in normoalbuminuria group ranged from 22 to 32, indicating moderate severity.

Nineteen individuals with normoalbuminuria and twelve with microalbuminuria had syntax scores greater than 32, which indicates significant damage.

Table 2: SYNTAX score.

Score	Severity
<22	Low
22 – 32	Intermediate
>32	High

Table 3: SYNTAX scores of study population.

Syntax score	Normoalbumin-uria, n=61 (%)	Microalbuminu -ria, n=16 (%)
<22	10 (16)	0
22-32	26 (42)	4 (25)
>32	19 (31)	12 (75)

The two groups with intermediate to severe lesions are compared, and the results indicate statistical significance.

Table 4: Statistical analysis of SYNTAX scores.

Syntax score	Chi-square	P value
<22	3.38	0.05
22-32	10.13	0.001

Following findings were found when the smokers' coronary lesion severity was compared. In the female group, there were no smokers. Thirty individuals were male and were reformed, smokers or ongoing smokers. Twenty-three patients out of the thirty smokers had intermediate to severe lesions, meaning their syntax score was greater than 22. Not significant; p value 0.65; Chi-square 0.194.

Sixteen of thirty smokers exhibited syntax scores of more than thirty-two, which indicates more serious coronary lesions.

Chi-square 5.96; p value 0.01; statistically significant.

Nine of microalbuminuria individuals did not smoke, while seven of them did.

Between them, five non-smokers and seven smokers demonstrated syntax scores higher than 32.

The remaining five nonsmokers scored below 32 on the syntax test.

This comparison's Chi-square of 4.14 and p value of 0.04 indicated that it was statistically significant.

It demonstrates the presence of severe and intricate coronary lesions in smokers with microalbuminuria.

Table 5: Smokers and CAD in the study group.

Syntax score	Normoalbumin-uria	Microalbuminu-ria
22 – 32	7	0
>32	16	7

In present investigation, four individuals having normoalbuminuria, as well as five individuals having microalbuminuria, had thin arteries with diffuse disease that were unsuitable for CABG. There was a statistically significant difference.

Chi-square 5.16; p value 0.02, significant to our investigation, as there are many variations and a small number of study participants.

DISCUSSION

Men in this investigation had significantly greater levels of microalbuminuria than women. This result was consistent with research conducted by Guo et al, Luo et al, and Parsa et al.[10-12]

According to the syntax score, serious coronary disease and microalbuminuria have been associated with accelerated aging in the present investigation. This was in accordance with other research by Guo et al, Parsa et al, and El Sherif et al that found a correlation between severe CAD along older adults.[12,13]

According to this investigation, smoking, as well as the severity of CAD, were significantly correlated. This had been consistent with earlier research by Luo et al, and Gou et al. Parsa et al disagreed with Nakaishi et al.

Smoking increases the risk of thrombogenesis via altering antithrombotic as well as prothrombotic factors, platelet dysfunction, and tissue factor along with tissue factor pathway inhibitor-1. Additionally, there is less tPA released, which results in less spontaneous fibrinolysis. One crucial stage in the development of atherosclerosis is the oxidative stress brought on by free radicals.[14] Superoxide and other free radicals interact to reduce nitrous oxide while simultaneously producing peroxy nitrite, which exacerbates oxidative stress in cells. Proatherogenicity and a prothrombotic condition are caused by increased oxidative stress and decreased nitrous oxide.

Possible causes and processes of CVDs associated with smoking. The primary mechanisms are indicated by the bold boxes.

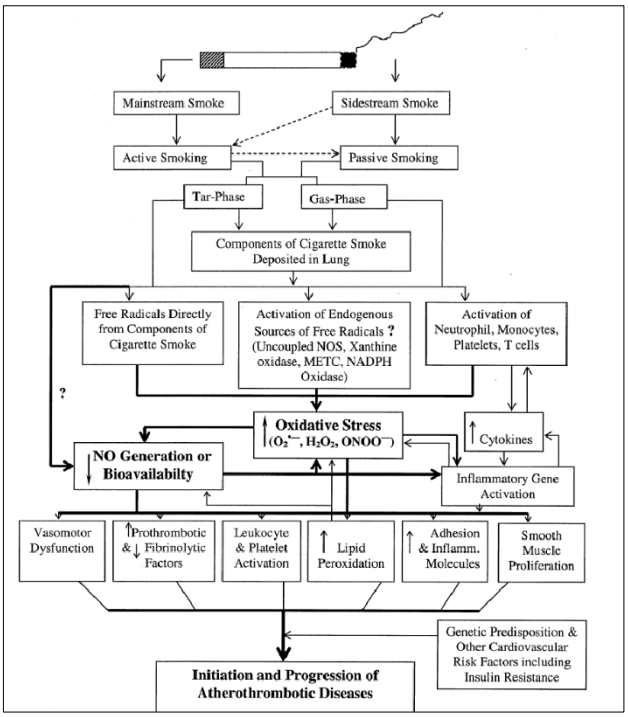

Figure 5: Association of smoking and severity of CAD.

No correlation among severity of microalbuminuria and coronary disease, as well as systemic systolic and diastolic blood pressure, BMI, HDL, along LDL cholesterol levels, had been observed. Although the present research's observation was different from that of Guo et al,[10] and Luo et al's earlier research, it was associated with Parsa et al. Ethnicity, drugs, geography, as well as the smaller sample size could all contribute to this discrepancy.

Extent of CAD and microalbuminuria had been observed to be statistically correlated in this investigation.

Twelve individuals in the group having microalbuminuria had a statistically significant syntax score of greater than 32, indicating serious CAD. This was related to other research on Devici et al, Sukhija et al, Sherif et al, Guo et al, and Parsa et al.[10,12,13,15,16]

Premature atherosclerosis and microalbuminuria both have nearly identical histological alterations. Dyslipidemia results from decreased lipoprotein lipase, which is caused by reduced heparin sulphate in vasculature's endothelial cells. This, in turn, results in lower clearance of VLDL. Endothelial dysfunction and lower-grade inflammation are prevalent among microalbuminuria patients.[17]

Additionally, microalbuminuria, as well as intermediate-severity CAD, are significantly correlated, according to this research. The association between the microalbuminuria group and coronary lesions of

intermediate severity that have a syntax score between 22 and 32 is statistically significant.

Additionally, the present investigation demonstrates that individuals having microalbuminuria had narrow arteries having diffuse disease, which isn't appropriate for CABG. This finding was statistically significant.

Limitations

The current study included a patient cohort from a single centre and comprised a largely homogenous south Indian population. Therefore, results may not be readily generalized to all patients. Moreover, this was an exploratory analysis. Albuminuria, of any grade, although with a well-established risk in Diabetes, has a highly skewed distribution, resulting in an imbalance between the number of diabetic patients having micro-albuminuria with those with normo-albuminuria and macro albuminuria. Because of the relatively small cohort size, it is difficult to establish a linear or any other type of relationship between the severity of coronary artery disease and presence of microalbuminuria in diabetic patients. Further studies are needed to delineate the relationship of microalbuminuria with disease severity of CAD in diabetic patients.

CONCLUSION

This investigation could lead to the following conclusions. A severe form of coronary disease with intricate as well as severe coronary lesions is predicted by the presence of microalbuminuria in people with T2DM. Elderly people having microalbuminuria and T2DM have serious coronary heart disease. Prevalence of microalbuminuria was more in males than in females. The severity of CAD was more among smokers with diabetes, particularly in those who had microalbuminuria. The prevalence of severe diffuse disease having thin arteries unsuitable for revascularization was higher in those with microalbuminuria. This study could be of benefit to a better understanding of the relationship between T2DM and the severity of coronary vessel disease, and in accordance, lead to better treatment and patient outcomes.

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