

Incidence of Proteinuria and Microalbuminuria in Type-2 Diabetes Mellitus

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ABSTRACT: Diabetic nephropathy is a dreaded complication of Type 2 diabetes mellitus. However in the early stages also known as incipient nephropathy it can be detected by the presence of microalbuminuria. The aim of our study was to know the occurrence of microalbuminuria in patients with Type 2 diabetes mellitus and to note its associations with the duration of diabetes since diagnosis and also the various macrovascular and microvascular complications of diabetes mellitus. A total of one hundred randomly selected diabetic patients satisfying the inclusion criteria were selected for the study. All patients were evaluated in detail along with the testing for microalbuminuria with dipsticks (Micral).

The overall occurrence of microalbuminuria was 38%. The occurrence of microalbuminuria showed a direct relationship with increasing age ($p=0.053$) and increasing duration of diabetes since diagnosis. An HbA1c value above 7% is associated with 50% or higher incidence of microalbuminuria ($p=0.018$). patients with a body mass index of more than 25 kg/m² have significant increase in the incidence of microalbuminuria ($p=0.027$). the incidence of microalbuminuria is significantly associated with the presence of retinopathy ($p=0.073$), peripheral neuropathy ($p=0.009$), ischemic heart disease ($p=0.011$) and hypertension ($p=0.001$). Microalbuminuria is inversely associated with HDL ($p=0.089$).

The occurrence of proteinuria and microalbuminuria in Type 2 diabetic patients of Hyderabad was quite high. During the evaluation of diabetic patients the possibility of microalbuminuria and its correlation with various complications of diabetes mellitus should be kept in mind.

KEYWORDS: Type 2 diabetes mellitus, Microalbuminuria, incipient diabetic nephropathy.

1. INTRODUCTION

Diabetes mellitus, the most common endocrine disorder is characterized by Metabolic abnormalities and long-term microvascular and macrovascular and macro vascular complications.

Microalbuminuria is most commonly associated with other microvascular complications of diabetes namely retinopathy, neuropathy and ischemic heart disease. So microalbuminuria may be a marker for widespread microvascular damage in a patient of diabetes mellitus.

The aim of this study was to study the occurrence of microalbuminuria in patients with non-insulin dependent diabetes mellitus and also to find out its association with the duration of diabetes mellitus and the microvascular complications and macrovascular complications of diabetes mellitus.

Keen and Chlouervakis (1963) developed sensitive specific radioimmunoassay for detecting human albumin in low concentration in urine to study the sub clinical increase in urine albumin excretion rate (AER), which might be the earliest pointer to the development of diabetic renal disease. A significant increase in mean AER was demonstrated in non-insulin dependent diabetic subjects. This AER was an average three to four times above the normal level. Later Mongenseh et al (1998) found increased AER in newly diagnosed youngsters with insulin dependent diabetes mellitus as did Parving et al in short term insulin dependent diabetes mellitus patients whose control had been deliberately worsened by withdrawal of insulin for some days. In established conventionally treated adult insulin dependent diabetes mellitus patients known to be diabetic between 6 months and 39 years, albumin and IgG excretion rates were

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found to be raised in 30 to 45% patients especially those patients with duration of diabetes between 10 and 20 years as mentioned by Alvin C. pomers (1990).

The main pathological features of diabetic kidney disease occur in the glomerulus, are discussed and explained by Roberto Frevesion et al (1997).

Glomerulus consists of tuft of 20-40 capillary loops, which arise from an afferent and drain into an efferent arteriole. Mesangial tissue, comprising both cellular and matrix components, support lobules of capillaries. Electron microscopy of the loops shows that each loop consists of a basement membrane lined by fenestrated endothelium and covered by viscera 1 epithelial cells (podocytes) carrying foot processes that interdigitate along the membrane, leaving spaces (filtration slits or pores) between the processes. The Bowman's capsule encloses the glomerular tuft, which is continuous with the tubular basement membrane and binds the urinary space. Filtration of plasma proceeds from the capillary, across the endothelium (probably via the fenestrae), the basement membrane, through the slit pores of the epithelium and into the urinary space and the proximal tubule has been suggested by Tishercc (1981).

In diabetes the volume of the whole kidney and of individual glomeruli is increased at the time of diagnosis 12 and glomeruli continue to enlarge later in the disease 12 13. Early glomerular enlargement is probably due to enhanced basement. Membrane production leading to an increased in filtration surface area while later expansion may be caused due to mesangial expansion was reported by Drummond and Maver M (2002) and white KE and Bilos RW (2003).

The increase in total renal volume is likely to be caused by tubular tissue. In diabetic nephropathy, renal size is therefore usually normal or large even when and stage renal failure develops, which is contrast to most causes of chronic renal failure in which renal size tends to decrease with advancing disease, in some cases however, concomitant renal artery stenosis or upper urinary tract infections may contribute to a reduction in overall renal size these findings are reported by Phillips Ao etal (2001) and Hostetter TH (2001).

II. MATERIAL AND METHODS

100 patients of diabetes (NIDDM) were taken from medical wards of the hospital based on random selection. Patients were considered to be diabetic based on WHO (2) criteria for diagnosis of diabetes mellitus.

Which is:-

1. Symptoms of diabetes mellitus plus a random glucose concentration ≥ 200 (11.1mmol/l). The classic symptoms of diabetes mellitus include polyuria, polydipsia and unexplained weight loss.
OR
2. Fasting blood glucose ≥ 126 mg/dl (7.0mmol/l). fasting is defined as no caloric intake for at least 8 hours.
OR
3. 2 hour post prandia 1 glucose ≥ 200 mg/dl (11.1 mmol/l). Among diabetics, the above criteria were considered to include the patients for the study.

Inclusion criteria for case selection:

- 1) Urine sugar – positive
- 2) Fasting blood suger >126 mg/dl

Exclusion criteria for case selection:

- 1) Patients with macroalbuminuria
- 2) Patients with congestive cardiac failure, urinary tract infection.
- 3) Ketounria
- 4) Prenant patients
- 5) Petients with overt diabetic nephropathy

The selected patients were studied in detail with history and physical examination.

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History:

*Patient's characteristics age, sex, age of onset and duration of diabetes.

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*All details regarding the presenting complaints were noted.

*Total duration of diabetes, the drugs the patients was taking and the dosages were noted. The regularity of the treatment taken by the patients was also noted. The family history regarding diabetes was taken.

*Personal history regarding smoking, alcohol consumption, bowel and habits bladder and drug intake were noted.

A complete clinical examination was carried out in each patient with particular reference to the complications of diabetes like retinopathy, neuropathy, diabetic foot and ischemic heart disease. Height and weight were measured in all cases and body mass index (BMI) was calculated by weight in kg/height in m².

Hypertension was said to be present when there was a history of hypertension or the systolic blood pressure was recorded greater than 160mm of hg and/or diastolic pressure greater than 90 mm of hg on 3 consecutive occasions.

Ischemic heart disease was recorded to be present in the presence of suggestive history of angina or myocardial infarction with electrocardiographic evidence. Peripheral neuropathy was judged to be present if there was historical evidence of neuropathic pain, numbness or tingling sensation in the extremities and or absence of ankle jerks along with diminished vibratory threshold or pin prick sensation in hands or feet on examination. Fundus examination was done in all patient for evidence of diabetic retinopathy. Retinopathy was said to be present when there was evidence of microaneurysm, soft or hard exudates and hemorrhages. Neovascularity was considered as evidence for proliferative retinopathy. Peripheral vascular disease was considered to be present with history of amputations and/or absent of one or more peripheral pulses and/or presence of gangrenous foot.

The following investigations were done in all the patients.

*Microalbuminuria was estimated by Micral test in all the cases.

*Fasting Blood suger and Postprandial blood suger

*Glycosylated hemoglobin

*Blood urea and serum creatinine

*Fasting lipid profile

*Urine routine and culture

*Electrocardiogram

*Ultrasonography of the abdomen, echocardiogram and chest x-ray were done in selected cases only.

Estimation of Microalbuminuria by Micral test: All patients having overt macroalbuminuria detected by albustic were excluded from study. Micral test, a immunological rapid dip stick semi qualitative technique for detection of microalbuminuria, was used for estimation of microalbuminuria.

Micral test components: I test strip contains monoclonal antibodies against human albumin (immunoglobulin G) labeled colloid gold 2.2mg, fixed albumin 7.7 mg.

Test Principle: There is a serial arrangement of several reagent pads, which are in fluid communication one step handling with a complex chemistry. The single reaction steps are as follows:

*Urine of the sample is transported through the wick fleece to the buffer fleece, where acidic urine is adjusted to proper pH.

Upon entering the conjugate freeze the antigen – antibody reaction takes place Albumin of the sample is specifically bound to a soluble conjugate of antibodies and marker enzyme resulting in an antigen – conjugate complex.

*The excess antibodies are bound to immobilized albumin on the capture matrix and removed from the sample in this way.

*Only the complex of conjugate with sample-albumin reaches the substrate pad. Here the color reaction takes place, the marker enzyme.

B-Galactosidase Cleaves off the purple dye chlorophenol red from the yellow substrate (chlorophenol red galactoside) in a kinetic reaction. The intensity of the colour produced is proportional to the albumin concentration in the urine.

Specimen Collection: All patients were afebrile during the course of collection of urine and were kept at rest during the collection of urine. Urine of the patient was first tested for albumin by albustix method. Patients who were negative for albumin by the albustix method were only include in this study.

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First morning mid stream urine sample that was collected in a sterile container was used for determining microalbuminuria. Test strip was immersed in urine such that fluid level was between the two black bars provided on the strips. Strip was withdrawn after 5 seconds. Strip was placed horizontally across the urine vessel and color change in the test zone was compared with color scale after one minute. Sensitivity of the kit is 0.4ng/m I and measuring range is 0.8 to 10ng/ml.

Microalbuminuria was graded as follows:

Mild (20-50mg/L)-+

Moderate (50-100mg/L)-++

Severe (100-300mg/L)-+++

Depending on the color change in the strip.

Severity of diabetes was graded based on the HbA1c levels, as follows:

Mild <7.0%

Moderate – 7.0% to 7.5%

Severe - > 7.5%

Blood urea, serum creatinine and lipid profile were estimated in all cases.

Statistical methods 75.76: Chi-square and Fisher Exact test have been used to find the significance of proportion of incidence of microalbuminuria between various levels of study parameters namely BMI, Age, Duration of DM, GHB %, abnormal lipid profile and complications etc. the Odds ratio has been used to find the strength of relationship between the incidence of microalbuminuria and other study parameters. Student ttest has been used to find the significance of mean levels of lab parameters between the presence and absence of microalbuminuria.

Statistical software: The Statistical software namely SPSS 11.0 and Systat 8.0 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

III. RESULTS

A Prospective clinical study consisting of 100 Type 2 DM patients is undertaken to investigate the pattern and magnitude of microalbuminuria and its relationship with microvascular and macrovascular complications of Type 2 DM.

Table 1 shows the age and sex distribution of patients

Age in years	Male		Female		Total
	No	%	No	%	No
30-40	9	15.7	7	16.28	16
41-50	14	24.56	9	20.93	23
51-60	15	26.32	16	37.21	31
61-70	14	24.56	6	13.95	20
>70	5	8.77	5	11.63	10
Tatal	57	100.00	43	100.0	100
Mean age ± SD	54.82 ± 12.38		54.82 ± 11.08		54.87 ± 11.59
Mean age of detection of DM	48.84 ± 10.11		48.75 ± 8.68		48.79 ± 9.27
P value	Mean age between male and female = 0.965 Mean age of detection of diabetes = 0.964				

Table1: Age and sex distribution

16 patients were in the age group between 30 and 40 years, among whom 9 were male and 7 were female patients. 23 patients were in the age group between 41 and 50 years, among whom 14 were male and 9 were female patients. 31

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patients were in the age group between 51 and 60 years, among whom 15 were male and 16 were female patients. 20 patients were in the age group between 61 and 70 years. Among whom 14 were male and 6 were female patients. 10 patients were in the age group greater than 70 years, among whom 5 were male and 5 were female patients. The mean age of male patients in the study was 54.82 ± 11.08 years. The mean age of detection of diabetes mellitus among the male patients was 48.84 ± 10.11 years and in the patients was 48.75 ± 8.68 years.

The mean age between male and female is not statistically significant with $p=0.964$ and the mean age of detection of DM is not statistically significant with $P=0.965$.

Table 2 shows the duration of diabetes mellitus since diagnosis

Duration of DM	Male (n=57)		Female (n=43)		Total (n=100)
	No	%	No	%	No
≤ 5.0	35	61.40	24	55.81	59
5.1-10.0	12	21.05	11	25.58	23
10.1-15.0	5	8.77	6	13.95	11
>15.0	5	8.77	2	4.65	7
Mean duration of DM ± SD	6.19 ± 4.31		6.11 ± 4.75		6.14 ± 4.54
P value	0.930				

Table 2: Duration of diabetes mellitus since diagnosis

A total of 59 patients had duration of diabetes since diagnosis less than 5 years among which 35 were male and 24 female patients. 23 patients had duration of diabetes since diagnosis between 5 years and 10 years among which 12 were male and 11 were female patients. 11 patients had duration of diabetes since diagnosis between 10 years 15 years among which 5 were male and 6 were female patients. 7 patients had duration of diabetes since diagnosis greater than 15 years among which 5 were male and 2 were female patients. The mean duration of diabetes since diagnosis was 6.19 ± 4.31 years among the male patients and 6.11 ± 4.75 years among the female patients. The mean duration of DM is not statistically significant between male and female patients with $p=0.930$.

Table 3 shows the number of patients with microalbuminuria in this study.

Microalbuminuria	Number
-	62
+	11
++	18
+++	9

Table 3: Number of patients with Microalbuminuria

There was 62 patients negative for microalbuminuria. 11 patients had microalbuminuria between 20 to 50 mg/l. 18 patients had microalbuminuria between 50 to 100 mg/l. finally 9 patients had microalbuminuria between 100 to 300mg/l as shown in table.3.

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Table 4 shows the number of patients on different treatment for diabetes mellitus.

Treatment	Number(n=100)
Insulin	4
OHA	84
OHA + Insulin	12

Table 4: Treatment

4 patients were on treatment with Insulin and 84 patients were on treatment with oral hypoglycaemic agents whereas 12 patients were on both insulin and oral hypoglycaemic drugs as reveals by table.4.

Table 5 shown the association of age with microalbuminuria

Age in years	Microalbuminuria				Total
	-	+	++	+++	
30-40	13	3	-	-	16
41-50	18	2	2	1	23
51-60	20	4	7	-	31
61-70	10	1	5	4	20
>70	1	1	4	4	10
Total	62	11	18	9	100
P value	Incidence of microalbuminuria is 2.54 times more Likely for age group >50 years P=0.053				

Table 5: Association of Age with Microalbuminuria

Among the 16 patients in the age group between 31 to 40 years 3 patients had microalbuminuria. 23 patients were in the age group between 41 to 50 years among whom 5 patients had microalbuminuria. 31 patients were in the age group between 51 to 60 years among whom 11 patients had microalbuminuria. 20 patients were in the age group between 61 to 70 years among whom 10 patients had microalbuminuria. 10 patients were in the age group greater than 70 years among whom 9 patients had microalbuminuria.

Incidence of Microalbuminuria is 2.54 times more likely for the age group >50 years of age as compared to the age group <50 years with $\chi^2 = 3.757$, $P=0.053$, as mentioned by table.5.

Table 6 shows the Association of Duration of DM since diagnosis with the incidence of Microalbuminuria.

Duration of Dm	Microalbuminuria				Total
	-	+	++	+++	
≤ 5.0	56	2	1	-	59
5.1-10.0	6	8	8	2	23
10.1-15.0	1	1	8	1	11
>15.0	-	-	1	6	7
P value	P < 0.001				

Table 6: Association of Duration of DM since diagnosis with the incidence of Microalbuminuria.

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The number patients with the duration of diabetes since detection less than 5 years were 59 and among them 3 were positive for microalbuminuria. The number patients with the duration of diabetes since detection 5 years and 10 years were 23 and among them 10 were positive for microalbuminuria. The number patients with the duration of diabetes since detection 10 years and 15 years were 11 and among them 10 were positive for microalbuminuria. All the patients i.e. 7 with duration were than 15 years were positive for microalbuminuria, as shown in table.6.

Table 7 shows the association of HbA1c with the incidence of microalbuminuria

HbA1c (n=100)	Microalbuminuria				Total
	-	+	++	+++	
< 6.5	16	4	1	1	22
6.5-7.0	17	2	2	1	22
7.0-7.5	12	2	2	-	16
>7.5	17	3	13	7	40
P value	▶ 7.0%, p= 0.018 ▶ 7.5%, p= 0.001				

Table 7: Association of HbA1c with the incidence of Microalbuminuria

22 patients had HbA1c values less than 6.5% and among them 6 were positive for microalbuminuria. 22 patients had HbA1c values between 6.5% and 7.0%, among them 5 were positive for microalbuminuria. 16 patients had HbA1c values between 7.0% and 7.5% among them 4 were positive for microalbuminuria. 40 patients had a HbA1c values more than 7.5%, among them 23 were positive for microalbuminuria, as presented in table.7.

Table 8 shows the association of body mass index with microalbuminuria

Body mass index (Kg/m ² (n=100)	Microalbuminuria				Total	OR
	-	+	++	+++		
< 19	5	-	1	1	7	0.63 (P=0.706)
19-25	48	3	14	6	71	0.44 (P=0.071a)
>25	9	8	3	2	22	3.06 (P=0.027*)
P value	P< 0.05					

Table 8: Association of body mass index with the incidence of Microalbuminuria.

7 patients had a BMI less than 19kg/m² and out of them 2 patients were positive for microalbuminuria. 71 patients had a BMI between 19kg/m² and out of them 13 patients were positive for microalbuminuria. Incidence of Microalbuminuria is significantly associated & Positively with BMI>25 and Negatively associated with BMI <25 kg/m² with P<0.05 as reveal in table.8.

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Table 9 shows the association of lipid parameters with the incidence of microalbuminuria

Lipid parameters (n=100)	Microalbuminuria					OR
	-	+	++	+++	Total	
T.Cholesterol (>200 mg/dl)	20	4	3	3	30	1:0.65 (P=0.359)
Triglycerides (>160 mg/dl)	21	6	7	3	37	1:1.42 (P=0.408)
LDL (>150 mg/dl)	6	-	3	2	11	1:1.41 (P=0.744)
HDL (>30 mg/dl)	17	3	8	5	33	1:1.93 (P=0.130)

Table 9: Association of Lipid Parameters with the incidence of Microalbuminuria

30 patients had total cholesterol greater than 200 mg/dl and among them 11 patients were positive for microalbuminuria. 37 patients had Triglycerides greater than 160 mg/dl and among them 16 patients were positive for microalbuminuria. 11 patients had LDL greater than 150 mg/dl and among them 5 patients were positive for microalbuminuria. 33 patients had HDL lesser than 30 mg/dl and among them 16 patients were positive for microalbuminuria.

Incidence of microalbuminuria is not significantly associated with the abnormal lipid parameters, however, the incidence of microalbuminuria is 1.93 times more likely for the patients presented with HDL <30 mg/dl, as shown in table.9.

Table 10 shows the association of complications with the incidence of microalbuminuria

complications (n=100)	Microalbuminuria					OR
	-	+	++	+++	Total	
Retinopathy	5	1	5	2	13	1:3.04 (P=0.073a)
Peripheral Neuropathy	18	5	10	6	39	1:3.02 (P=0.009**)
Peripheral vascular diseases	4	-	2	2	8	1:1.71 (P=0.474)
Ischemic heart Disease (IHD)	8	3	9	1	21	1:3.51 (P=0.011*)
Hypertension	5	-	13	5	23	1:10.26 (P<0.001**)
BMI (>25 kg/M ²)	9	8	3	2	22	1:3.06 (P=0.027*)

Table 10: Association of complications with the incidence of microalbuminuria

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13 patients had retinopathy, among them 8 patients were positive for microalbuminuria. 39 patients had peripheral neuropathy, among them 21 patients were positive of microalbuminuria. 8 patients had peripheral vascular disease, among them 4 patients were positive for microalbuminuria. 21 patients has Ischemic heart Disease (IHD), among them 13 patients were positive for microalbuminuria. 23 patients had hypertension, among them 18 patients were positive for microalbuminuria. 22 patients had a BMI above 25 kg/m² and out of them 13 patients were positive for microalbuminuria, as shown in table.10.

Table 11 shows the mean pattern of laboratory parameters in the presence of microalbuminuria.

Lab parameters	Microalbuminuria (Mean± SD)		Significance by student test
FBS mg/dl	172.39±26.22	194.44±34.39	P<0.001**
PPBS mg/dl	244.97±30.19	273.92±48.49	P<0.001**
GHB%	7.06±0.81	8.06±1.41	P<0.001**
Blood Urea mg/dl	29.19±6.02	29.95±6.81	P=0.555
S.Creatinine mg/dl	1.04±0.16	1.05±0.19	P=0.915
T.Cholesterol mg/dl	188.09±29.61	188.74±38.75	P=0.926
TGL mg/dl	153.31±60.06	164.61±63.52	P=0.374
LDL mg/dl	125.97±21.75	125.58±26.82	P=0.937
HDL mg/dl	31.46±3.52	30.23±3.40	P=0.089a

Table 11: Mean pattern of laboratory parameters in the presence of microalbuminuria.

The mean value of FBS in the presence of microalbuminuria was 194.44±34.39 mg/dl and 172.39±26.22 mg/dl in the absence of microalbuminuria. The mean value of PPBS in the presence of microalbuminuria was 273.92±48.49 mg/dl and 244.97±30.19 mg/dl in the absence of microalbuminuria. The mean value of GHB% in the presence of microalbuminuria was 8.06±1.41% and 7.06±0.81% in the absence of microalbuminuria. The mean value blood urea of in the presence of microalbuminuria was 29.95±6.81 mg/dl and 29.19±6.02 mg/dl in the absence of microalbuminuria. The mean value serum creatinine of in the presence of microalbuminuria was 1.05±0.19 mg/dl and 1.04±0.16 mg/dl in the absence of microalbuminuria. The mean value of total cholesterol in the presence of microalbuminuria was 188.74±38.75 mg/dl and 188.09±29.61 mg/dl in the absence of microalbuminuria. The mean value of triglycerides in the presence of microalbuminuria was 164.61±63.52 mg/dl and 153.31±60.06 mg/dl in the absence of microalbuminuria. The mean value of LDL cholesterol in the presence of microalbuminuria was 125.58±26.82 mg/dl and 125.97±21.75 mg/dl in the absence of microalbuminuria. The mean value of HDL cholesterol in the presence of microalbuminuria was 30.23±3.40 mg/dl and 31.46±3.52 mg/dl in the absence of microalbuminuria, as mentioned in table.11.

IV. DISCUSSION

Type 2 diabetes mellitus is being increasingly recognized as a disease, which is characterized by dysfunction of the endothelium. Endothelial dysfunction occurs in a generalized and widespread manner in diabetic subjects. The severity of the dysfunction is directly proportional to the age of the patient and duration of the diabetes. The clinical markers of the generalized endothelial dysfunction becomes manifest in several forms. Microalbuminuria marks the onset of endothelial dysfunction related to the kidney. Since its original description by Mogensen, the estimation of microalbuminuria is made easy and practical. Microalbuminuria serves as a warning for imminent nephropathy. But its true value is that it heralds generalized endothelial dysfunction. Thus diabetic subjects with microalbuminuria not only have ongoing progressive nephropathy but are also likely to have retinopathy, nephropathy and cardiovascular problems including coronary artery disease and hypertension. An effort has been made in this study to highlight this

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issue. Even among randomly selected patients an incidence of 38% for microalbuminuria is evident. Among various other studies the prevalence of microalbuminuria ranges from 25% to 35% 78, 79, 80, 81. A slight increase in the percentage of microalbuminuria in our study can be attributed to several factors such as, large number of elderly patients, longer duration of diabetes and poor glycemic control.

It is very well recognized that microalbuminuria occurs more commonly in diabetic subjects who are more than 50 years of age. In our study microalbuminuria tended to be 2.54 times more common in the age group of above 50 years as compared to the age group of less than 50 years. There are many reasons for this phenomenon. Firstly deterioration in the β -cell function, which occurs paripassu with increasing duration of diabetes, is likely to contribute to worsening glycemic control. Poor values of HbA1c are known to be associated with increasing incidence of microalbuminuria. In our study only 11 out of 44 patients who had a normal HbA1c ($<7.0\%$) manifested microalbuminuria, whereas with HbA1c values more than 7, 27 out of 56 (nearly 50%) had microalbuminuria. It is seen from the above result that even small increments of HbA1c more than 7.0% result in almost doubling of the incidence of microalbuminuria.

It is also interesting to note that when HbA1c rises above 7.0%, 22 out of 27 patients tended to have more than 50mg/l and 7 out of 27 had microalbuminuria touching 300mg/l.

Although this is a cross sectional study, these findings raise concern regarding the blatant association between poor glycemic control and microalbuminuria in a rural setting.

This study has also brought out a significant association of microalbuminuria with body mass index of more than 25 kg/m². Of the 22 patients with BMI of more than 25, 13 had microalbuminuria (52%). Similar findings have been brought forth by other studies 79,80, 81.

The possible explanation for this could be

1. Increasing body mass index is a reflection of insulin resistance which in turn leads to endothelial dysfunction and microalbuminuria.
2. Associated hypertension may also be responsible for microalbuminuria.
3. Poor glycemic control which in turn is an outcome of insulin resistance is also held responsible.

The present study has also brought out the correlation between lipid parameters and microalbuminuria. Although no correlation could be found between microalbuminuria and hypertriglyceridemia and hypercholesterolemia, the incidence of microalbuminuria is 1.93 times more likely for the patients who present with HDL values of less than 30mg/dl. A similar inverse relationship between HDL and microalbuminuria has been described in many studies 77, 78, 79, 81, 82, 83.

The incidence of microalbuminuria is significantly associated with the presence of retinopathy ($p=0.073$), peripheral neuropathy ($p=0.009$), ischemic heart disease ($p=0.01$), hypertension ($p=0.001$) and body mass index ($p=0.027$) more than 25kg/m². Peripheral neuropathy and hypertension have the most significant association with microalbuminuria. This association is not surprising since both hypertension and neuropathy are dependent on similar risk factors. It is also well known that retinopathy and microalbuminuria have a high concordance rate. Several studies have highlighted the occurrence of microalbuminuria as a marker of ischemic heart diseases 78, 81, 83. Our study also underscores this point. Out of the total 38 patients with microalbuminuria, 13 of them had ischemic heart disease.

V. CONCLUSION

Following conclusions are drawn from the present study

1. The incidence of microalbuminuria is estimated to be 38% in this study.
2. Microalbuminuria shows a direct relationship with increasing age of patients and increasing duration of diabetes mellitus since diagnosis.
3. A HbA1c value above 7% is associated with 50% or higher incidence of microalbuminuria.
4. Patients with a body mass index of more than 25kg/m² have significant increase in the incidence of microalbuminuria.

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5. Incidence of microalbuminuria is significantly associated with presence of hypertension, neuropathy, Ischemic heart disease, retinopathy and high body mass index.
6. Microalbuminuria is inversely associated with HDL.

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