# Study Of Albumin Creatinine Ratio And Urine B2 Microglobulin In Type 2 Diabetes Mellitus Patients And Its Correlation With Microvascular Injury

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**ABSTRACT**

**Aims and objectives:** The present study was conducted to study the correlation between urinary β2 microglobulin and albumin creatinine ratio in diabetic patients, diabetic nephropathy, diabetic neuropathy and diabetic retinopathy.

**Materials and Methods:** All patients admitted (in-patient) with Type 2 Diabetes mellitus under the department of General Medicine, Mahatma Gandhi Hospital from January 2021 to June 2022 was included in the study. About 6.0 ml venous blood from each study subject was collected into a plane test tube following standard procedure. Tube was labeled with the patient's identification number and kept in a vertical position at room temperature (22˚C - 24˚C) for 30 minutes. Then blood was centrifuged at 3000 rpm/minutes in room temperature (22˚C - 24˚C) for 15 minutes. Serum was separated by micro-pipette and collected to appendrope, then preserved at −20˚C until further analysis.

The random plasma glucose was assessed by automated biochemistry analyzer on the principle of photometric technique, serum creatinine was measured by kinetic method and serum β2 microglobulin was assessed by ELISA method.

**Results:** Association between diabetic groups with urinary β2 microglobulin, creatinine and albumin creatinine ratio were showed statistically significant results. HBA1C showed positive correlation with creatinine, urinary β2 microglobulin and albumin creatinine ratio among all four groups.

**Conclusion**: Urinary β2 microglobulin, creatinine and Albumin creatinine ratio were showed any significant relationship with diabetic groups.

**Keywords:** β2 microglobulin, albumin creatinine, ratio

## Introduction

Diabetes mellitus is one of the most common endocrine metabolic diseases. The microvascular and macrovascular complications, resulting in nephropathy, retinopathy, neuropathy, and ischaemic heart disease has been emphasized. According to recent estimates from the International Diabetes Federation (IDF), 463 million adults are currently living with diabetes. The IDF estimates that there will be 578 million adults with diabetes by 2030 and 700 million by 2045. Globally, 11.3% of deaths are due to diabetes.[1]

Associated with the increasing prevalence of diabetes mellitus is a concomitant increase in the incidence of diabetic nephropathy.[2] This has already occurred in other parts of Africa like Egypt where the prevalence of diabetic ESRD steadily increased from 8.9% in 1996 to 14.5% in 2001. There is also a higher mortality in ESRD due to diabetes mellitus than ESRD from other etiologies.[3] Ignorance of the populace of the renal damaging effects of diabetes mellitus will also contribute to the increasing burden of end stage renal disease. Late diagnosis and inadequate treatment of DM may predispose to the development and progression of DN in our population.

More recently, attention has been focused on the use of persistent microalbuminuria to define the presence of incipient diabetic nephropathy[4] and initial work on microalbuminuria attributed excretion of >30mg/day of albumin in urine to be due to increased glomerular filtration of albumin. Though the glomerular origin of microalbuminuria has not been contested, studies in rodents and man have shown that impaired tubular reabsorption of albumin at the proximal convoluted tubule is partly responsible for microalbuminuria.[5] One study suggests that the initial renal damage resulting in microalbuminuria is the loss of charge-dependent tubular protein reabsorption occurring prior to the damage of the glomerular charge barrier in diabetics while another has shown in diabetic children that tubular proteinuria actually predates microalbuminuria.[6]

A host of urinary biomarkers of tubular dysfunction have been the subject of investigation in diabetic nephropathy studies. Kidney injury molecule -1, N-acetyl-beta-D-glucosaminidase, glutathione – S – transferase, neutrophil gelatinase associated lipocalin, urinary cystatin C, Netrin-1, alpha1-microglobulin and beta2-microglobulin have all been identified as important urinary tubular injury markers for the detection of early nephropathy either alone or as a panel of tests.[7] Urinary β2-microglobulin production in normal individuals is constant at about 0.13mg/hour/kg and is exclusively eliminated by the renal tubules by degradation by the proximal tubular cells after being freely filtered through the glomerular filtration barrier.[8] Proximal tubular dysfunction leads to an increased urinary concentration of this molecule. The foregoing suggests that investigations targeting the tubular function in diabetics may be of immense clinical benefit in detecting early diabetic nephropathy, possibly earlier than the occurrence of persistent microalbuminuria.

Unirnary β2 microglobulin is a low molecular weight protein produced by cells expressing Major Histocompatibility Complex Class 1 (MHC-1) and found in all nucleated cells. Because it is almost entirely filtered by the glomerulus, it can be used to determine the glomerular filtration rate.[9] The precision and accuracy of GFR estimation with creatinine were dissatisfactory because it is influenced by an external factor such as the variation of muscle mass. In addition, Abdullah et al. suggested that it also could be used as a marker of early DN.[10]

Based on the close connection between DN and kidney disease, we hypothesize that some well-known markers of renal injury can be used to predict DN early. A previous study reported that elevated urinary albumin/creatinine ratio (UACR) and decreased eGFR, markers of glomerular injury, might be predictive factors of DN.[11] In recent years, markers of renal tubular injury such as urinary N-acetyl-β-D-glucosaminidase/creatinine ratio (NAG/Cr) and

urinary β2 microglobulin (β2-MG) also played an important role in the early prediction of kidney disease.[12]

Considering all this scenario into consideration, our study was aimed (a) to assess the levels of microalbuminuria, glycated hemoglobin, urinary creatinine, urinary albumin to creatinine ratio (ACR) along with blood urea and serum creatinine in patients with type 2 DM, and (b) to observe the incidence of microvascular injury at tertiary care center; and correlate the presence of microvascular injury to the duration of DM as well as with ACR.

## MATERIALS AND METHODS

- Type of Study: A Hospital based study
- Period of Study: January 2021 to June 2022
- Place of Study: Mahatma Gandhi Medical College & Hospital, Jaipur
- Institute Ethics Committee approval was obtained before start of study.
- Written and informed consent of the patients were obtained from all participants before enrolment into the study.
- SAMPLE SIZE: All patients admitted (in-patient) with Type 2 Diabetes mellitus under the department of General Medicine, Mahatma Gandhi Hospital from January 2021 to June 2022 was included in the study.

**Inclusion criteria:**

- Patients with type 2 diabetes mellitus
- Informed consent

**Exclusion criteria:**

- Patients with Type 1 Diabetes mellitus
- Patients who already have end stage renal disease other than diabetes/CKD.
- Patients who already have diabetic neuropathy.
- Patient who already have diabetic retinopathy.
- Patients who refused to participate in the study.

## METHODOLOGY

Patients admitted under General Medicine of Mahatma Gandhi Medical College and Hospital, was undergo a detailed medical history and a thorough physical examination.

**Study tools**

- Laboratory Investigations – Blood sugar, Blood Urea, Serum Creatinine, Glycosylated hemoglobin (HbA1c), Urinary micro albumin and urinary creatinine.
- Fundal examination and Nerve conduction velocity test

**Analysis of blood samples**

About 6.0 ml venous blood from each study subject was collected into a plane test tube following standard procedure. Tube was labeled with the patient's identification number and kept in a vertical position at room temperature (22˚C - 24˚C) for 30 minutes. Then blood was centrifuged at 3000 rpm/minutes in room temperature (22˚C - 24˚C) for 15 minutes. Serum was separated by micro-pipette and collected to appendrope, then preserved at −20˚C until further analysis.

The random plasma glucose was assessed by automated biochemistry analyzer on the principle of photometric technique, serum creatinine was measured by kinetic method and serum β2 microglobulin was assessed by ELISA method.

**Methods of assay**

Blood sugar, Blood Urea, serum creatinine – Autoanalyzer method.

Urinary β2 microglobulin – Nephlometric method

HbA1c - Nephlometric method

Urinary Creatinine – Jaffe's Method.

The urine albumin (microalbumin) to urinary creatinine was calculated by the formula[13]

Stages of diabetic nephropathy [modified from the renal association[14]

| Stage | GFR (ml/min/1.73 $m^2$) | Description | Management |
|---|---|---|---|
| 1 | >90 | Normal or increased GFR with another evidence of renal damage | Screening CKD and risk reduction |
| 2 | 60-89 | Slightly decreased GFR with another evidence of renal damage | Diagnosis and treatment: slow progression of CKD; comorbidities and cardiovascular disease; risk reduction |
| 3a | 45-59 | Moderately decreased GFR without evidence of renal damage | Evaluate and treat complication |
| 3b | 34-40 | Irreversible renal damage | |
| 4 | 15-29 | Severely decreased GFR without evidence of renal damage | Prepare for renal replacement therapy |
| 5 | <15 | Established renal failure | Renal replacement if uremic |

For nephropathy:
1: Urine albumin creatinine ratio (U.ACR estimation):- Based on U.ACR value staging of chronic kidney diseases (CKD) was done as normal or mild (<30 mg/24 h), microalbuminuria (30–300 mg/24 h), and macroalbuminuria (>300 mg/24 h).
2: e GFR estimation (calculated by using CKD epidemiology collaboration equation) by using serum creatinine value:- Based on eGFR value, the staging of CKDs were done as Stage-1 CKD (>90 mL/min), Stage-2 CKD (60–89 mL/min), Stage-3A CKD (45–59 mL/min), Stage-3B CKD (30–44 mL/min), Stage-4 CKD (15–29 ml/min), and Stage-5 CKD (<15 mL/min).

**Methods for the diagnosis of diabetic peripheral neuropathy[15]**

| Examination name | Examination type | Advantages | Disadvantages |
|---|---|---|---|
| Clinical symptoms & signs | DN4, LANSS, NPQ, MNSI, DNS, TCNS, NDS, UENS | Relevant to the patient, easy to use, inexpensive | Limited sensitivity, high variability |
| Quantitative sensory testing | CASE IV (WR Medical Electronics), Biothesiometer, Thermoaesthesiometer, TSA Neurosensory Analyser (Medoc Ltd.) | Easy to perform, rapid, non-invasive, evaluates large and small nerve fibers | Variable, subjective, requires special equipment |
| Sudomotor function | Neuropad (Skyrocket Phytopharma), Sudoscan (Impeto Medical), QSART, sympathetic skin response | Fast, objective, easy to perform, simple, reproducible | Moderate sensitivity, uncertain interpretation |

| | | | |
|---|---|---|---|
| Neurophysiology | NCS of motor and sensory nerves | Objective, widely available | Only assesses large fibers, moderate reproducibility, requires special equipment |
| Skin punch biopsy | IENFD | Objective, gold standard to assess small fibers | Costly, time-consuming, risk of infections requires specialist equipment and personnel to quantify IENFD |
| Corneal confocal microscopy | HRT III RCM | Objective, rapid, reproducible, assesses small fibers | Costly, requires specialist equipment |

DN4, Douleur Neuropathique en 4; LANSS, Leeds Assessment of Neuropathic Symptoms and Signs; NPQ, Neuropathic Pain Questionnaire; MNSI, Michigan Neuropathy Screening Instrument; DNS, Diabetic Neuropathy Symptom; TCNS, Toronto Clinical Neuropathy Score; NDS, neuropathy disability score; UENS, Utah Early Neuropathy Scale; QSART, Quantitative Sudomotor Axon Reflex Test; NCS, nerve conduction studies; IENFD, intra-epidermal nerve fiber density; HRT III RCM, Heidelberg Retina Tomograph III Rostock Corneal Module.

For neuropathy:

Nerve conduction study (NCS):- Based on the NCV value of tibial nerve, staging of diabetic neuropathy was done as absent neuropathy (>5 mv), mild neuropathy (2.5–5 mv) and severe neuropathy (<2.5 mv). Treatment was started after confirmation of clinical diagnosis and appropriate referral was done whenever required.

**Criteria and degree of urgency for referral of a patient with DR to the ophthalmologist.**

| | | |
|---|---|---|
| Lesions requiring immediate assessment by the ophthalmologist | Proliferative retinopathy | (i) New vessels on the optic disc or at any location in the retina |
| | | (ii) Preretinal hemorrhage |
| | Advanced diabetic retinopathy | (i) Vitreous hemorrhage |
| | | (ii) Fibrotic tissue (epiretinal membrane) |
| | | (iii) Recent retinal detachment |

| | | |
|---|---|---|
| | | (iv) Iris neovascularization |
| Lesions that should be referred to the ophthalmologist for assessment as soon as possible | Preproliferative retinopathy | (i) Venous irregularities |
| | | (ii) Multiple hemorrhages |
| | | (iii) Multiple cotton-wool exudates |
| | | (iv) Intraretinal microvascular abnormalities (IRMA) |
| | Nonproliferative retinopathy with macular involvement | (i) Decreased visual acuity uncorrected with a pinhole occluder (suggestive of macular edema) |
| | | (ii) Microaneurysms, hemorrhages, or exudates within less than one disc diameter of the center of the macula (with or without vision loss) |
| | Nonproliferative retinopathy without macular involvement | (i) Hard exudates with a circinate or plaque pattern in the major temporal vascular arcades |
| | Any other finding that the observer could not be interpreted with a reasonable degree of certainty | |
| Lesions requiring follow-up control (every 6–12 months) but should not be referred to the ophthalmologist | Nonproliferative retinopathy | (i) Hemorrhages or microaneurysms occasionally or hard exudates beyond one disc diameter of the center of the macula |
| | | (ii) Isolated cotton-wool exudates without preproliferative associated lesions |

Ophthalmic evaluation

Standard diagnostic criteria were applied, and investigations like direct and indirect ophthalmoscopy, fundus photography, and OCT were performed after complete clinical examination. Those cases with fundus showing features of DR were graded on the basis of ETDRS classification. Patients with DR were further subclassified into two groups based on presence or absence of clinically significant macular edema (CSME).

**Statistical analysis**

The data was coded and entered into Microsoft Excel spreadsheet. Analysis was done using SPSS version 20 (IBM SPSS Statistics Inc., Chicago, Illinois, USA) Windows software program. Descriptive statistics included computation of percentages, means and standard deviations. The data were checked for normality before statistical analysis using Kolmogorov Simonov test. The ANOVA test (for quantitative data to compare two and more than two

observations) was applied. The chi square test was used for quantitative data comparison of all clinical indicators. Level of significance was set at P≤0.05.

**Observation and results**

The mean age among Diabetes without microvascular injurywas 59.54 years, diabetic neuropathy was 61.54 years, diabetic nephropathy was 60.43 years, and diabetic retinopathy was 59.09 years. Comparison of age among diabetic group showed statistically non-significant results.

Majority of patients were male in all the category i.e 71.4% in Diabetes without microvascular injury, 71.4% in Diabetic neuropathy, 68.6% Diabetic nephropathy and 68.6% in Diabetic retinopathy respectively. Majority of patients were Feale in all the category i.e 28.6% in Diabetes without microvascular injury, 28.6% in Diabetic neuropathy, 31.4% Diabetic nephropathy and 31.4% in Diabetic retinopathy respectively. Comparison of gender among diabetic group showed statistically non-significant results.

Pallor was absent in maximum percentage of patients with findings of pallor in Diabetes without microvascular injury (17.1%), Diabetic neuropathy (11.4%), Diabetic nephropathy (14.3%) and Diabetic retinopathy (14.32%). Comparison of pallor among diabetic group showed statistically non-significant results.

Icterus was absent in maximum percentage of patients across all the groups. Icterus was present in Diabetes without microvascular injury (28.6%), Diabetic neuropathy (31.4%), Diabetic nephropathy (28.6%) and Diabetic retinopathy (31.4%) respectively. Comparison of icterus among diabetic group showed statistically non-significant results.

Edema was absent in maximum percentage of patients across all the groups. Edema was present in in Diabetes without microvascular injury (20%), Diabetic neuropathy (38.9%), Diabetic nephropathy (27.8%) and Diabetic retinopathy (57.6%) respectively. Comparison of edema among diabetic group showed statistically significant results.

Table 1: Comparison of diabetic groups with Hba1c

| | N | Mean | Std. Deviation | P value |
|---|---|---|---|---|
| Diabetes without microvascular injury | 35 | 10.14 | 1.62 | 0.001 (S) |
| Diabetic neuropathy | 35 | 12.59 | 1.11 | |
| Diabetic nephropathy | 35 | 14.53 | 1.57 | |
| Diabetic retinopathy | 35 | 15.23 | 1.28 | |

The mean of Hba1c was higher among patients with diabetic retinopathy (15.23) as compared to Diabetes without microvascular injury (10.14), Diabetic nephropathy (14.53) and Diabetic neuropathy (12.59), however it was statistically significant.

Table 2: Association between diabetic groups with Creatinine

| | N | Mean | Std. Deviation | P value |
|---|---|---|---|---|
| Diabetes without microvascular injury | 35 | 1.38 | .68 | 0.001 (S) |
| Diabetic neuropathy | 35 | 2.57 | 0.71 | |
| Diabetic nephropathy | 35 | 3.03 | 0.13 | |
| Diabetic retinopathy | 35 | 4.71 | 0.82 | |

The mean of creatinine was higher among patients with diabetic retinopathy (4.71) as compared to Diabetes without microvascular injury (1.38), Diabetic nephropathy (2.57) and Diabetic neuropathy (3.03), however it was statistically significant.

Table 3: Association between diabetic groups with urinary β2 microglobulin

| | N | Mean | Std. Deviation | P value |
|---|---|---|---|---|
| Diabetes without microvascular injury | 35 | 607.81 | 328.21 | 0.001 (S) |
| Diabetic neuropathy | 35 | 667.80 | 340.59 | |
| Diabetic nephropathy | 35 | 705.89 | 359.36 | |
| Diabetic retinopathy | 35 | 759.11 | 324.56 | |

The mean of urinary β2 microglobulin was higher among patients with diabetic retinopathy (759.11) as compared to Diabetes without microvascular injury (607.81), Diabetic nephropathy (705.89) and Diabetic neuropathy (667.8), however it was statistically significant.

Table 4: Association between diabetic groups with Albumin creatinine ratio

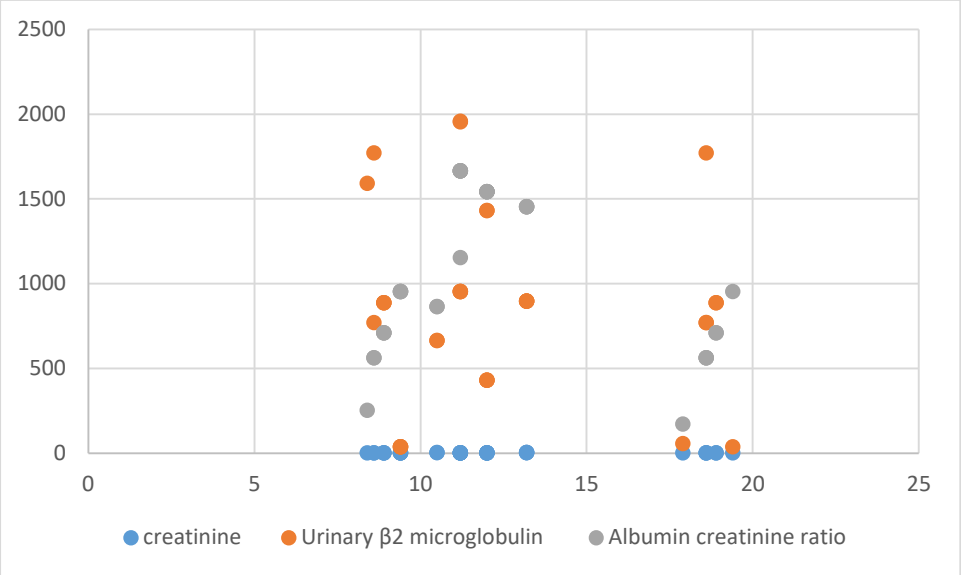
| | N | Mean | Std. Deviation | P value |
|---|---|---|---|---|
| Diabetes without microvascular injury | 35 | 935.400 | 482.06 | 0.001 (S) |
| Diabetic neuropathy | 35 | 953.67 | 421.71 | |
| Diabetic nephropathy | 35 | 994.874 | 484.64 | |
| Diabetic retinopathy | 35 | 1265.1 | 321.53 | |

The mean of Albumin creatinine ratio (ACR) was higher among patients with diabetic retinopathy (1265.1) as compared to Diabetes without microvascular injury (935.4), Diabetic nephropathy (994.87) and Diabetic neuropathy (953.67), however it was statistically significant.

Table 5: Correlation of HBA1C with Creatinine, Urinary β2 microglobulin and Albumin creatinine ratio

| | | Creatinine | Urinary β2 microglobulin | Albumin creatinine ratio |
|---|---|---|---|---|
| Diabetes without microvascular injury | Pearson Correlation | .055 | .112 | .246 |
| | P value | .001 (S) | .001 (S) | .001 (S) |
| Diabetic neuropathy | Pearson Correlation | .935 | .545 | .884 |
| | P value | .001 (S) | .001 (S) | .001 (S) |
| Diabetic nephropathy | Pearson Correlation | .243 | .181 | .512 |
| | P value | .001 (S) | .001 (S) | .001 (S) |
| Diabetic retinopathy | Pearson Correlation | .092 | .057 | -.181 |
| | P value | .001 (S) | .001 (S) | .001 (S) |

HBA1C showed positive correlation with creatinine, urinary β2 microglobuminemia and albumin creatinine ratio among all four groups.




## Discussion

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. Diabetes mellitus (DM) is one of the primary risk factors for developing renal impairment globally. Both type 1 and type 2 DM may lead to chronic complication of diabetic nephropathy. The presence of trace amount of albumin in urine (microalbuminuria) has a good prognostic value in predicting early renal damage (initial nephropathy). Approximately, one-third of diabetic patients develop microalbuminuria after 15 years of the onset of disease, whereas full nephropathy can develop in nearly half of the patients developing micro-albuminuria with collateral risks of developing cardiovascular disease. Abnormal albumin levels in urine can be detected in 30% of patients diagnosed with type 2 DM. Presence of protein in urine can speed up the development of the renal disorder and subsequently lead to end-stage renal failure. However, several aspects of mechanisms leading to the development of albuminuria are actively researched. Albumin creatinine ratio in random urine samples is the most appropriate investigation to detect early renal impairment. [16, 17]

In the present study, Diabetes without microvascular injury was 59.54 years, diabetic neuropathy was 61.54 years, diabetic nephropathy was 60.43 years, and diabetic retinopathy was 59.09 years. In a study by Rasheed R et al [18] Mean age of the study group was 58.89 years. In a study by vijakumar et al, mean age of the participants was 54.50 years.[19] In a study by Chowta N K etal [20] the mean age of patients was at diagnosis ranged between 30–70 years. Creatinine clearance has shown slight negative correlation with microalbuminuria in the present study, though statistically insignificant. Serum creatinine and creatinine clearance was within normal range in all the patients. Diabetic nephropathy can conveniently be categorized into different stages with respect to renal hemodynamics, systemic blood pressure, urinary findings, and susceptibility to therapeutic interventions. In the initial renal hyperperfusion stage, glomerular filtration is elevated with absent albuminuria. In the second stage (clinical latency) glomerular filtration will be high normal with absent albuminuria. Next stage is incipient nephropathy, wherein glomerular filtration will be normal with presence of microalbuminuria. It usually appears 5–15 years after the diagnosis of diabetes mellitus. In the subsequent stage, glomerular filtration decreases with appearance of macroproteinuria and clinical manifestations of nephropathy. Finally ends up in endstage renal disease with massive albuminuria and diminished glomerular filtration.[21] Hence

microalbuminuria may not be associated with abnormal serum creatinine or creatinine clearance, but can be an important warning signal which if ignored can result in irreversible renal damage.

Glycosylated haemoglobin is non enzymatic addition of a sugar residue to haemoglobin. When glucose is bound non-enzymatically to a terminal portion of Hb chain, its quantization becomes possible. This measurement is directly proportional to blood glucose concentration. As life span of RBCs is 120 days, this test, with allowances for the dynamics of RBCs production & disposal, indicate mean blood glucose over a 2- 3month period. At present, the consensus on best method for measuring glycosylated haemoglobin is to use a fractionated value of HbA1c. The normal value of HbA1c is < 6.9% of total haemoglobin.[22]

Microvascular diabetic injury complications include a field of conditions that cause significant damage at what could be considered a slow and steady pace. The pathobiological characteristic of microvascular damage is basement membrane thickening in different systems mostly but not limited to the eyeball, kidney disease and mostly peripheral neuropathy.[23] Basement membrane thickening creates a hypoxic condition due to altered vascular diffusion, homeostatic alteration and maintained glucotoxicity in small vessels and capillaries. From these systems, clinical symptoms such as renal failure, blindness, amputations, and predict future cardiovascular issues. Understanding early clinical symptoms has the potential to significantly reduce the number of deaths by cardiovascular events by promoting early treatment. Furthermore, given the severity of atherosclerosis in diabetes, these patients have a greater likelihood of end-organ ischemia.[24, 25, 26]

In the present study, The mean of Hba1c was higher among patients with diabetic retinopathy (15.23) as compared to Diabetes without microvascular injury (10.14), Diabetic nephropathy (14.53) and Diabetic neuropathy (12.59), however it was statistically significant. The mean of creatinine was higher among patients with diabetic retinopathy (4.71) as compared to Diabetes without microvascular injury (1.38), Diabetic nephropathy (2.57) and Diabetic neuropathy (3.03), however it was statistically significant. The mean of urinary β2 microglobulin was higher among patients with diabetic retinopathy (759.11) as compared to Diabetes without microvascular injury (607.81), Diabetic nephropathy (705.89) and Diabetic neuropathy (667.8), however it was statistically significant. The mean of Albumin creatinine ratio (ACR) was higher among patients with diabetic retinopathy (1265.1) as compared to Diabetes without microvascular injury (935.4), Diabetic nephropathy (994.87) and Diabetic neuropathy (953.67), however it was statistically significant. HBA1C showed positive correlation with creatinine, urinary β2 microglobulin and albumin creatinine ratio among all four groups.

The opposite result was found by Karmakar RN et al, concurrence of diabetic neuropathy and albuminuria has been found to be significantly associated.[27] Microalbuminuria is significantly associated with presence of neuropathy.[28] Singh et al.[29] showed that increase in urinary albumin excretion correlates with the development of proliferative retinopathy. In Saini DC et al study,[30] the non-significant association of severity of diabetic retinopathy with severity of diabetic nephropathy and diabetic neuropathy in diabetic patients. Dhonde S et al,[31] did not showed relationship between microalbuminuria in patients with type 2 diabetes mellitus.

**Conclusion**

The study showed that urinary β2 microglobulin, creatinine and Albumin creatinine ratio were showed any significant relationship with diabetic group. Results of our study confirm and extend the previous observations in small selected groups of patients with type-2 diabetes mellitus. Creatinine clearance will be within normal range in microalbuminuric patients. But the presence of microalbuminuria alerts the physician to prevent further renal damage by

timely administration of ACE inhibitors and correction of risk factors. Urinary excretion of albumin should be monitored routinely in patients with diabetes mellitus.

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