Evaluation of Micro albuminuria and HbA1c in type 2 Diabetes Mellitus Patients in Shendi town ,sudan

Abstract:

Background: Diabetes mellitus (DM) is a systemic metabolic disorder that may result in diabetic nephropathy (DN) which is a common cause of end-stage renal disease worldwide**.**

Objectives: This study was aimed to assess microalbuminuria and HbA1c levels in patients with diabetes mellitus in shendi town- Sudan.

Materials and Methods: This hospital-based case-control study was conducted in Shendi town- Sudan. During the period June-October 2021 A total of 50 subjects were enrolled in this study, of which 30 subjects with clinically confirmed diabetes were included as cases, while 20 apparently healthy subjects were enrolled as controls. Blood and random urine sample were collected from each case and control in this study and estimated for the level of microalbuminuria and hemoglobin A1C (HbA1C) by using A25 chemistry analyzer and Ichroma immuno-analyzer respectively. Data was collected by using structured questionnaire and analyzed by using SPSS version 20.

Results: Our study found an increase in mean microalbuminuria in patients compared to controls (26.4 ±38.2 vs 11.4 ± 9.2 mg/l, *P value* = 0.000). This study showed a significant increase in mean hemoglobin A1C levels in the case group compared to the control group (7.38±2.2 vs5.7 ± 0.76 % *P value* = 0.001). Our study results also showed that there was no correlation between microalbuminuria and disease duration.

Conclusions: Levels of microalbuminuria were increased compared to controls. HbA1c levels were increased compared to the control group. In our study group, there was a weak positive correlation between microalbuminuria and patient's age.

Keywords: diabetes mellitus type 2, Microalbuminuria, HbA1C.

Introduction:

Diabetes is a metabolic disorder of global importance, characterized by varying degrees of insulin resistance, impaired insulin secretion, and increased glucose production **[1].** The consequences of diabetes mellitus include long-term damage, dysfunction, and dysfunction of various organs. The two main types of this syndrome are type 1 (usually onset in childhood and adolescence and patients require lifelong insulin injections for survival), and patients with type 2 diabetes have high It has a long asymptomatic glycemic period and often develops many complications by the time of diagnosis **[2].**Diabetic nephropathy is a common consequence of long-standing diabetes mellitus. It is characterized by the presence of large amounts of proteins, mainly albumin, in the urine. Diabetic nephropathy is the leading cause of end-stage renal disease (ESRD) in the United States and the leading cause of diabetes-related morbidity and mortality **[3].**

HbA1c is a glycemic control marker in diabetic patients. Glycated hemoglobin (HbA1c) is the result of post-translational alterations in the hemoglobin molecule, and its levels correlate well with blood glucose levels over the past 6-10 weeks. Glycosylation of hemoglobin occurs under physiological conditions by a reaction between glucose and the N-terminal valine of the beta chain of the molecule **[4].** Higher HbA1C levels are associated with the risk of developing microangiopathy in diabetic patients. associated with an increase. This may be due to the fact that HbA1c has a specific affinity for oxygen, causing tissue anoxia and being involved in the development of micro- and macroangiopathy **[5].** Several studies have shown a positive correlation between microalbuminuria and his HbA1c **[6,7].** 347 million people worldwide have diabetes **[8].**An estimated 3.4 million people died in 2004 from high fasting blood sugar **[9].**More than 80% of deaths from diabetes **[10].** Recent statistics from the World Health Organization (WHO) predict that the prevalence of diabetes will increase worldwide, especially in developing countries **[11].** India currently has the highest number of people with diabetes, and this number is expected to increase further in the coming years **[11,12].**

The term "microalbuminuria" (MA) It started in 1964 when it was first used by Professor Harr Keen to detect small amounts of albumin in the urine of his type 1 diabetic **[13].** The

next mention of MA in the literature came five years after him, when Keen et al **[14].** examined MA as part of an oral glucose tolerance test. However, it was not until his late 1970s that Mogensen and Vittinghus **[16].** and his Viberti et al **[15].** studied the effect of insulin treatment on exercise-induced MA and examined albumin excretion in relation to glycemic control. In the 1980s, a flurry of research by these authors and their respective collaborators investigated the association between MA and end-organ injury and attempted to understand the pathophysiology of MA **[17,18].** Microalbuminuria predicts progression to diabetic nephropathy and cardiovascular disease **[20].**

Materials and methods:

Study design:

Case-control study conducted in Shendi City from June to October 2021. In this study, a total of 50 subjects were included of which 30 are diabetic patients as cases and 20 apparently healthy subjects as a control group. Approval for this study was obtained from the Ethics Committee of the Department of Clinical Laboratory Sciences. All subjects included in this study were fully informed of the purpose of the study. Prophylactic samples were taken with full commitment, privacy, and confidentiality. Analytical results were used for clinical diagnosis and were provided free of charge to all patients participating in the study. Patients with renal disease were excluded from this study.

Sample collection and analysis

Blood samples were collected using a topical skin antiseptic (70% ethanol). Five ml of venous blood was collected from each diabetic and non-diabetic control male and female using sterile disposable plastic syringes. Blood was collected from the cuboid vein or the back of the hand. Puncture urine samples were collected and refrigerated at -20 °C. Blood and random urine sample were estimated for the level of microalbuminuria and hemoglobin A1C (HbA1C) by using A25 chemistry analyzer and Ichroma immuno-analyzer respectively.

Data collection and analysis

Data was collected by using structured questionnaire and analyzed by using SPSS version 20.

Ethical approval

Patients undergoing the test were given explanations of the venous blood sample process. All participants were informed about the research objectives and procedures during the interview period. Written valid consent was obtained from all participants. All result was with high privacy and confidentiality.

Results:

The analysis shows the baseline characteristics of the study groups between the patient mean and the control group, with significant differences in microalbuminuria between cases and controls (26.4 ±38.2 vs 11.4 ± 9.2 mg/l, *P value* = 0.001) **(table 1).** We also show the baseline characteristics of hemoglobin A1c between the means of patients and controls, the significant difference in hemoglobin A1c between cases and controls (7.38±2.2 vs5.7 ± 0.76 % *P value* = 0.001) **(table 1).** The analysis also shows The correlation between Microalbuminuria and (hba1c , year , duration , gender ,type , disease) by use Correlation coefficient(Pearson , spearman's) and probability value *(P-value* =0.05) .the correlation between Microalbuminuria and hba1c by used Pearson Correlation coefficient there is no correlation (r=0.3 , *p-value* =0.09) **(table 2).** The correlation between Microalbuminuria and year by used spearman's Correlation coefficient there is significant weak positive correlation (r=0.,4 *p-value* =0.007), and the correlation between Microalbuminuria and (duration , gender, type ,disease) by used spearman's Correlation coefficient there is no correlation (r=0.26, *p-value* =0.15), (r=-0.15, *p-value* =0.40), (r=- 0.02, *p-value* =0.88) , (r=-0.03, *p-value*=0.85) respectively **(table 2).**

(Table 1): The mean, standard deviation, and probability value (*P-value*) of Microalbuminuria, and HbA1C.

Test	*Groups*	*Mean ± SD*	*P-value*
Microalbuminuria (mg/l)	*Case*	26.4 ±38.2	0.001
	Control	11.4 ± 9.2	
HbA1c (%)	*Case*	7.38± 2.2	0.000
	Control	5.7 ± 0.76	

(Table 2): The correlation between Microalbuminuria and (hba1c , year , duration , gender)

Variables	*Correlation coefficient*	*P-value*	*Decision*
Microalbuminuria vs hba1c	0.3	0.09	No correlation
Microalbuminuria vs age/years	0.4	0.007	weak correlation
Microalbuminuria vs duration of disease	0.26	0.15	No correlation
Microalbuminuria vs gender	-0.15	0.40	No correlation

- **Discussion:**

Microalbuminuria is an early predictor and sensitive assay for detecting urinary albumin excretion that may precede the development of overt nephropathy in diabetes. Prompt detection and treatment can reduce risk and delay the onset of ESRD. The study was conducted with a test group of 30 diabetic patients and a control group of 20 healthy non-diabetic patients. The frequency results indicated that DM was similar in females and males, with percentages in females (50%) and males (50%). When blood glucose levels rise, glucose binds to proteins, resulting in excessive protein glycosylation and increased glycated end-products. Glomerular deposition of these advanced glycation end-products is increased, leading to renal and glomerular hypertrophy and thickening of the

glomerular basement membrane. This allows albumin (a low molecular weight protein) to leak out. This condition is called early nephropathy [microalbuminuria]. In this study, there was a significant increase in microalbuminuria in case studies compared to controls (p value = 0.000). Similar to microalbuminuria (Mohomed Ahsan), microalbuminuria was higher (in terms of higher HbA1c) in patients with uncontrolled type 2 diabetes (p-value 0.0349) **[21].**

The current study shows a highly significant increase in glycated hemoglobin levels in the test group compared to the control group *(P-value* = 0.001). This study is consistent with the results of (Pampareddy B. Kollur) **[22].** Elevated levels of urinary FBG, HbA1c, and microalbumin were evident compared to controls. The mean ± SD of FBG, HbA1c, and urinary microalbumin were statistically significantly increased in diabetic compared with non-diabetic patients (*P*<0.0001). Similar to a study conducted by (Goud) who found that glycated hemoglobin and fasting blood glucose levels were significantly increased in the diabetic group compared to healthy subjects (*p-value* = 0.001) **[23].** Also in this study, there was a significant weak positive correlation between years of diabetes mellitus and microalbuminuria in the test group (r = . 0392, *p-value* 0.03). Based on the results of this study, we recommend the following: Diabetics should be checked for microalbuminuria annually to assess kidney status. All people with diabetes should have their Hba1c measured at least every 6 months. Further studies are needed to determine other parameters for assessing nephropathy, especially in diabetes.

Conclusion:

The level of microalbuminuria was increased among cases group compared to the control group. HbA1c levels were increased among cases group compared to the control group. In our study group, there was a weak positive correlation between microalbuminuria and patient age.

References:

1. **DEFRONZO, Ralph A.** Pathogenesis of type 2 diabetes mellitus. Medical clinics, 2004, 88.4: 787-835.

2. **Satchell SC, Tooke JE.** What is the mechanism of microalbuminuria in diabetes: a role for the glomerular endothelium? Diabetologia. 2008 May;51(5):714-25. doi: 10.1007/s00125-008-0961-8. Epub 2008 Mar 18. PMID: 18347777; PMCID: PMC2292427.

3. **Powers A C. Diabetes Mellitus. In: Jameson JL.** (editor)Harrison's Endocrinology. 1st ed. New York: McGraw-Hill;2006. p 303–4.

4. **Kareem I, Jaweed SA, Bardapurkar JS, Patil VP.** Study of magnesium, glycosylated hemoglobin and lipid profile in diabetic retinopathy. Indian J Clin Biochem. 2004 Jul;19(2):124-7. doi: 10.1007/BF02894270. PMID: 23105469; PMCID: PMC3454207.

5. **Davis RE, Nicol DJ, McCann VJ, Calder JS.** Glycosylated haemoglobin levels in patients with diabetes mellitus. Med J Aust. 1978 May 20;1(10):530-2. doi: 10.5694/j.1326-5377.1978.tb141945.x. PMID: 683056.

6. **Gupta DK, Verma LK, Khosla PK, Dash SC.** The prevalence of microalbuminuria in diabetes: a study from north India. Diabetes Res Clin Pract. 1991 May;12(2):125-8. doi: 10.1016/0168-8227(91)90089-v. PMID: 1879303.

7. **Schmitz A, Vaeth M.** Microalbuminuria: a major risk factor in non-insulin-dependent diabetes. A 10-year follow-up study of 503 patients. Diabet Med. 1988 Mar;5(2):126-34. doi: 10.1111/j.1464-5491.1988.tb00958.x. PMID: 2964977.

8. **Danaei G, Finucane MM, Lu Y, Singh GM, Cowan MJ, Paciorek CJ, Lin JK, Farzadfar F, Khang YH, Stevens GA, Rao M, Ali MK, Riley LM, Robinson CA, Ezzati M;** Global Burden of Metabolic Risk Factors of Chronic Diseases Collaborating Group (Blood Glucose). National, regional, and global

trends in fasting plasma glucose and diabetes prevalence since 1980: systematic analysis of health examination surveys and epidemiological studies with 370 country-years and 2·7 million participants. Lancet. 2011 Jul 2;378(9785):31-40. doi: 10.1016/S0140-6736(11)60679-X. Epub 2011 Jun 24. PMID: 21705069.

9. WORLD HEALTH ORGANIZATION. Global health risks: mortality and burden of disease attributable to selected major risks. World Health Organization, 2009.

10. **Mathers CD, Loncar D**. Projections of global mortality and burden of disease from 2002 to 2030. PLoS Med. 2006 Nov;3(11):e442. doi: 10.1371/journal.pmed.0030442. PMID: 17132052; PMCID: PMC1664601.

11. **King H, Aubert RE, Herman WH**. Global burden of diabetes, 1995-2025: prevalence, numerical estimates, and projections. Diabetes Care. 1998 Sep;21(9):1414-31. doi: 10.2337/diacare.21.9.1414. PMID: 9727886.

12. **Ramachandran A, Snehalatha C, Latha E, Vijay V, Viswanathan M**. Rising prevalence of NIDDM in an urban population in India. Diabetologia. 1997 Feb;40(2):232-7. doi: 10.1007/s001250050668. PMID: 9049486.

13. **KEEN H, CHLOUVERAKIS C.** URINARY ALBUMIN EXCRETION AND DIABETES MELLITUS. Lancet. 1964 Nov 28;2(7370):1155-6. doi: 10.1016/s0140-6736(64)92674-1. PMID: 14213577.

14. **Keen H, Chlouverakis C, Fuller J, Jarrett RJ**. The consomitants of raised blood sugar: studies in newly-detected hyperglycaemics. II. Urinary albumin excretion, blood pressure and their relation to blood sugar levels. Guys Hosp Rep. 1969;118(2):247-54. PMID: 5804067.

15. **Mogensen CE, Vittinghus E.** Urinary albumin excretion during exercise in juvenile diabetes. A provocation test for early abnormalities. Scand J Clin Lab Invest. 1975 Jul;35(4):295-300. doi: 10.1080/00365517509095743. PMID: 1188285.

16. **Viberti GC, Jarrett RJ, McCartney M, Keen H.** Increased glomerular permeability to albumin induced by exercise in diabetic subjects. Diabetologia. 1978 May;14(5):293-300. doi: 10.1007/BF01223019. PMID: 648761.

17. **Viberti GC, Hill RD, Jarrett RJ, Argyropoulos A, Mahmud U, Keen H.** Microalbuminuria as a predictor of clinical nephropathy in insulin-dependent diabetes mellitus. Lancet. 1982 Jun 26;1(8287):1430-2. doi: 10.1016/s0140-6736(82)92450-3. PMID: 6123720.

18. **Hommel E, Mathiesen E, Edsberg B, Bahnsen M, Parving HH.** Acute reduction of arterial blood pressure reduces urinary albumin excretion in type 1 (insulin-dependent) diabetic patients with incipient nephropathy. Diabetologia. 1986 Apr;29(4):211-5. doi: 10.1007/BF00454877. PMID: 3710012.

19. **Maahs DM, Snively BM, Bell RA, Dolan L, Hirsch I, Imperatore G, Linder B, Marcovina SM, Mayer-Davis EJ, Pettitt DJ, Rodriguez BL, Dabelea D.** Higher prevalence of elevated albumin excretion in youth with type 2 than type 1 diabetes: the SEARCH for Diabetes in Youth study. Diabetes Care. 2007 Oct;30(10):2593-8. doi: 10.2337/dc07-0450. Epub 2007 Jul 13. PMID: 17630264.

20. **Tobe SW, McFarlane PA, Naimark DM**. Microalbuminuria in diabetes mellitus. CMAJ. 2002 Sep 3;167(5):499-503. PMID: 12240818; PMCID: PMC121969.