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# EVALUATION OF RENAL FUNCTION IN SUDANESE DIABETIC AND HYPERTENSIVE PATIENTS IN SHENDI LOCALITY AT RIVER NILE STATE

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## Abstract

Microalbuminuria in urine is a known indicator of renal dysfunction. It has been extensively studied in the diabetes mellitus and hypertensive patients. This study was cross-sectional, descriptive case-control, hospital based, conducted, in Shendi locality at River Nile State in Northern Sudan, from March to July 2018. It intended to examine the effect of diabetes mellitus and hypertension on renal function. Urine and venous blood samples were collected sixty (60) volunteer subjects, thirty-five (35) of them known as diabetic and hypertensive patients as case group, twenty-five (25) healthy subjects as control group. Samples were examined for urine microalbuminuria and plasma creatinine levels. Case and control groups were compared by age, gender and exercise. Albumin/Creatinine Ratio (ACR). was also assessed. The mean microalbuminuria and mean ACR were significantly higher in case group (38.304mg/dl, (6.8226) mg/mmol) compared to control group (13.020mg/dl, 2.4512) mg/mmol.), with statistically significant P. value (0.007) and (0.000) respectively. There was statistically insignificant variation of the means of plasma creatinine between case and control groups (0.88, 0.948) mg/dl with P. value of (0.285). The present study concluded that diabetes and hypertension were associated with microalbuminuria and renal dysfunction.

*Keywords:* Diabetes mellitus; Hypertension; Microalbuminuria; Albumin/Creatinine Ratio (ACR); Creatinine.

## 1. Introduction and Literature Review

Diabetes mellitus is a syndrome of chronic hyperglycemia due to relative insulin deficiency, resistance or both (American Diabetes Association. 2010).

The International Diabetes Federation estimates that the number of people with diabetes will increase globally from (366) million in 2011 to (552) million by 2030. The number of people with type 2 diabetes is increasing in every country and 80% of people with diabetes live in low- and middle-income countries. The greatest number of people with diabetes are between (40 to 59) years of age. (183) million people, around (50%) with diabetes are undiagnosed. Diabetes caused (4.6) million deaths in 2011 globally (IDF Diabetes Atlas:2011). Hypertension is even more common, rising in prevalence in the same countries, with a recent worldwide estimate of (1.39) billion cases (K.T. Mills, et al 2016).

In Sudan, the national prevalence of diabetes in adults is (7.7%). It could be even higher in some Northern states of the country, reaching figures of about (19%) and is expected to reach (10.8%) in 2035 (Global health estimates. WHO. 2014. Global status report on non-communicable diseases 2014. Saeed M. Omar. et al 2019). Diabetes mellitus exerts a significant burden resulting in increased morbidity and mortality, decreased life expectancy and reduced quality of life, as well as loss of income for individuals and nations. (Hind Eliadarous. 2017). Diabetes mellitus accounts for (1.8%) of all deaths in Sudan (Sudan Health Profile 2015).

Diabetes type 2 and hypertension are common co-morbidities. Hypertension is frequently twice in patients with diabetes, compared with those who do not have diabetes. They have also similar risk factors, with substantial overlap in the cardiovascular complications related primarily to microvascular and macrovascular diseases. Many of the underlying molecular mechanisms, including oxidative stress, inflammation, and fibrosis causing microvascular and macrovascular complications of diabetes, vascular remodeling and dysfunction in hypertension. (Petrie JR, et al 2017; Fowler MJ.208)

Diabetic nephropathy is the leading cause of renal failure in the United States. It is defined by proteinuria > 500 mg in 24 hours in the setting of diabetes. It is preceded by lower degrees of proteinuria, or "microalbuminuria." Microalbuminuria is a risk marker for cardiovascular events and possibly for kidney disease development. (George L, et al.2014).

Microalbuminuria is the presence of albumin in urine above the normal level but below the detectable range of conventional urine dipstick methods. It is the albumin excretion of (30-299) mg/24 hours (20 to 200) μg/min, or an albumin-creatinine ratio of (30 to 300) μg/mg creatinine. (McPherson RA, et al 2017)

Patients with microalbuminuria have significant abnormalities in the kidney, including glomeruli. This is quite clear in patients with type 1 diabetes, but is also seen in type 2 diabetes, where on the other hand, other risk factors such as hypertension and dyslipidemia also seem to be of importance, including loss of autoregulation. The clinical course of microalbuminuria is usually progressive. Therefore, it is an important marker for more pronounced diabetic vascular disease (Mogensen C.2003).

Without intervention, microalbuminuria typically progress to proteinuria and overt diabetic nephropathy. Like other microvascular complications of diabetes, there are strong associations between glucose control as measured by hemoglobin A1c (A1C) and the risk of developing diabetic nephropathy. Treatment with angiotensin-converting enzyme (ACE) has been shown to

decrease the risk of developing nephropathy and cardiovascular events in patients with type 2 diabetes (Fowler MJ.2008).

## 2. Objectives

The General objective of the study was to assess the renal function in diabetic and hypertensive patients in Shendi Locality at River Nile state in Northern Sudan, using microalbuminuria. Albumin/Creatinine Ratio (ACR), and plasma creatinine as early indicators of renal dysfunction.

## 3. Materials and Methods

The present study was cross-sectional, descriptive case-control, hospital based study, conducted, in Shendi locality at River Nile State in Northern Sudan. Sixty (60 ) volunteer subjects were enrolled in the study, thirty five (35) of them known as diabetic and hypertensive patients as case group, twenty five (25) healthy subjects as control group .In the case group, there were fourteen (14) patients with diabetes mellitus only, twelve (12) with hypertension only, and nine (9) with both. Patients with any disease or disorder that can affect the parameters such as microalbuminurea, plasma creatinine and Albumin/Creatinine Ratio (ACR) were excluded from the study.

Structural interview questionnaire was filled by the principal investigator. Random urine sample and three (3) ml of venous blood were collected in heparinized containers by standard procedure from each participant.

Microalbumin in urine was measured by Ichroma, using spectrophotometer and Ichroma reader. Creatinine was assayed by the Jaff's kinetic assay method using standard working reagents.

## 4. Ethical Clearance

Ethical approval for the study was obtained from the Board of the Faculty of Graduates Studies and Scientific Research in Shendi University. Verbal informed consent for participation in the study was obtained from each participant before recruitment into the study. There was full commitment precaution in sample taking procedure, privacy and confidentiality of the participants.

## 5. Data Analysis

All collected data was analyzed using SPSS for windows, version 16. Paired Student t-test was used for calculating the degree of variation, with $P$ .value ($\leq$0.05) was considered as significant. Analysis of variance (ANOVA) was used for continuous data and the statistical results were presented as means $\pm$ SD.

## 6. Results

Table 1: The means and standard deviation of microalbuminuria, ACR and plasma creatinine in case (diabetic and hypertensive) and control groups:

| Group | No & percentage (%) | Microalbuminuria (mg/dl) | ACR (mg/mmol) | Plasma creatinine (mg/dl) |
|---|---|---|---|---|
| Case | (35), (58.3 %) | 38.30 ±44.97 | 6.82 ±3.99 | 0.880 ±0.21 |
| Control | (25), (41.7 %) | 13.02 ±3.03 | 2.45 ±0.63 | 0.948 ±0.27 |
| P-value | | 0.007 | 0.000 | 0.285 |

*P*. value ≤0.05 (significant), by T. test.

Table 2: The means and standard deviation of microalbuminuria, ACR and plasma creatinine in diabetic patients and control groups:

| | No & percentage (%) | Microalbuminuria (mg/dl) | ACR (mg/mmol) | Plasma creatinine (mg/dl) |
|---|---|---|---|---|
| D.M | (23), (40 %) | 47.53 ±58.84 | 6.79 ±4.66 | 0.88 ±0.26 |
| Control | (25), (41.7%) | 13.02 ±3.03 | 2.45 ±0.63 | 0.94 ±0.27 |
| *P*. value | | 0.005 | 0.000 | 0.494 |

Table 3: The means and standard deviation of microalbuminuria, ACR and plasma creatinine in hypertensive patients and control groups:

| | No & percentage (%) | Microalbuminuria (mg/dl) | ACR (mg/mmol) | Plasma creatinine (mg/dl) |
|---|---|---|---|---|
| HTN | (21), (34.3%) | 16.40 ± 7.16 | 7.061 ± 3.66 | 0.86 ± 0.17 |
| Control | (25) . (41.7%) | 13.02 ± 3.03 | 2.45 ± 0.63 | 0.948 ± 0.27 |
| *P*. value | | 0.049 | 0.000 | 0.356 |

Table 4: The means and standard deviation of microalbuminuria, ACR and plasma creatinine in diabetic and hypertensive patients and control group:

| | No & percentage (%) | Microalbuminuria (mg/dl) | ACR (mg/mmol) | Plasma creatinine (mg/dl) |
|---|---|---|---|---|
| DM+HTN | (9), (25.7 %) | 53.14 ± 42.22 | 6.54 ± 3.72 | 0.888 ± 0.19 |
| Control | (25), (41.7 %) | 13.02 ± 0.03 | 2.45 ± 0.63 | 0.948 ± 0.27 |
| *P*. value | | 0.000 | 0.000 | 0.558 |

Table 5: The means and standard deviation of microalbuminuria, ACR and plasma creatinine, according to age of case group:

| Age | No &percentage (%) | Microalbuminuria (mg/dl) | ACR (mg/mmol) | Plasma creatinine (mg/dl) |
|---|---|---|---|---|
| Less than 50 years | (14), (40 %) | 36.24±14 | 7.16±14 | 0.786 ±14 |
| More than 50 years yrs | (21). (60 %) | 39.67±21 | 6.59± 21 | 0.943 ± 21 |
| *P*. value | | 0.829 | 0.690 | 0.031 |

ANOVA was test used

Table 6: The means and standard deviation of microalbuminuria, ACR and plasma creatinine, according to gender of the case group:

| Gender | No& percentage (%) | Microalbuminuria (mg/dl) | ACR (mg/mmol) | Plasma creatinine (mg/dl) |
|---|---|---|---|---|
| Males | (22), (62.9 %) | 39.33±22 | 6.12± 22 | 0.94 ± 22 |
| Females | (13), (37.1 %) | 36.55±/ 13 | 8.00±13 | 0.77± 13 |
| *P*. value | | 0.863 | 0.183 | 0.026 |

ANOVA test was used

Table 7: The means and standard deviations of microalbuminuria, ACR and plasma creatinine according to exercise in case group:

| Exercise | No, percentage (%) | Microalbuminuria mg/dl | ACR mg/mmol | Plasma creatinine mg/dl |
|---|---|---|---|---|
| Yes | 51.5 % | 44.40±18 | 6.95±18 | 0.917 ±18 |
| No | 48.5 % | 31.84±/17 | 6.67±17 | 0.841 ±17 |
| *P* .value | | 0.417 | 0.839 | 0.304 |

ANOVA test used

## 7. Discussion

According to the findings of this study as observed in table (1). the mean microalbuminuria (mg/dl) was higher in the case group than control group, (38.30, 13.02) respectively , with statistically significant *P*. value of (0.007).This result was supported by the findings of (Camille A. Jones, et al.2002) in the survey of microalbuminuria in the US population, that its prevalence was 28.8% in persons with previously diagnosed diabetes in US.

The mean of Albumin/Creatinine Ratio (ACR) was higher in the case than control group (6.82, 2.45 mg/mmol), respectively so it is higher than control group with statistically strong significant *P*. value of (0.000).

The mean of plasma creatinine was (0.88, 0.948) mg/dl in the case and control group, with statistically insignificant *P*. value of (0.28).

In table (2), it was obviously demonstrated that the mean of microalbuminuria in patients with diabetes mellitus was higher than in control group (47.53, 13.02 mg/dl) , respectively with statistically significant *P*. value of (0.005) .The mean of ACR in was higher in diabetic patients than control group, (6.79 , 2.45) mg/mmol respectively with statistically significant *P*. value of (0.000) .While the mean of plasma creatinine was (0.88 , 0.94) mg/dl for diabetes and control group respectively, with statistical insignificance *P*. value of (0.494).

The mean of microalbuminuria was higher in hypertensive than control group (16.40, 13.02) mg/dl, respectively, with statistically significant *P*. value of (0.049). as depicted in table (3). This agreed with what previously stated by (Palatini P .2003) in his review of microalbuminuria in hypertension that " Its prevalence rates going from a low of 4.7% to a high of 46%. " Also in this table the mean of ACR was higher in hypertensive than control group (7.06, 2.45) mg/mmol respectively, with statistical significant *P*. value of (0.000), while the plasma creatinine was found to be (0.866, 0.948) mg/dl, for hypertension and control group respectively, with statistical insignificance *P*. of (0.356) .

Table (4) showed that the mean of microalbuminuria elevated in diabetics with hypertension than control group (53.14, 13.02) mg/dl with statistically significant *P*. value of (0.000). This agreed with the findings projected by (Da Silva Marques P   et al. 2015)  in their  study of prevalence of microalbuminuria in hypertensive patients with or without type 2 diabetes in a Portuguese primary care setting who   found that " The highest prevalence (58%) was observed among hypertensive diabetics, closely followed by normotensive diabetics (51%). The prevalence among non-diabetic hypertensive's was 43% and 49.3% of all hypertensive's, markedly higher than the 12% observed among controls."  .Also the mean of ACR in diabetics with hypertension was is higher than the mean of the control group (6.54 , 2.45) mg/mmol with statistically significant *P*. value of  (0.000) , while the mean of plasma creatinine was (0.888, 0.948) mg/dl in diabetics with hypertension and control group respectively with  statistically insignificant *P*. value of (0.558) .

Table (5) demonstrated no impact of age on the mean of microalbuminuria and ACR mg/mmol in the case group with statistically insignificant *P*. value of (0.829) and (0.690) respectively.  On the other aspect age had profound impact on mean of plasma creatinine in case group, which was higher in the older age group (more than 50 years) (0.943, 0.786) mg/dl with *P*. value of (0.031). The gender had no effect on microalbuminuria mg/dl and ACR mg/mmol, with elevated plasma creatinine in male than females (0.941, 0.777) mg/dl with statistically significant *P*. value of (0.026). This finding partially agreed with what had been stated by (N. K. Chowta,et al. 2009) in their study of  microalbuminuria in diabetes mellitus, who stated that  "Gender-wise correlation analysis of microalbuminuria failed to show any statistical significance", and that . " Incidence of microalbuminuria increases with age as well as with increased duration of diabetes mellitus".

Table (7) showed no oblivious effect of exercise on all of the three renal function parameters discussed above.

### 8. Conclusion

On the basis of these study findings, it could be concluded that:

- Microalbuminuria and ACR were higher in diabetics, hypertensives and patients with both diabetes and hypertension.
- The plasma creatinine level was higher in the older age group.
- The plasma creatinine was higher in males than females.
- Age, gender, exercise had no significant impact on microalbuminuria and ACR.

## 9. Recommendations

- Regular evaluation of microalbuminuria for diabetic and hypertensive patients for early detection and correction of renal impairment.
- Improve health education and preventive programs for diabetes and hypertension and their complications for all population sectors.

## Competing Interests

The authors declare that they have no competing interests.

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