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STUDY ON THE ASSOCIATION BETWEEN HYPERURICEMIA & ALBUMINURIA IN PATIENTS WITH TYPE 2 DIABETES MELLITUS

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ABSTRACT

Hyperuricemia is an independent risk factor for kidney dysfunction in diabetic patients. Various findings suggest that uric acid is an inflammatory factor and may have a role in endothelial dysfunction and act as a mediator of diabetic nephropathy. On the other hand, albuminuria is considered as the predicator of early stages of diabetic nephropathy. We investigated the correlation between hyperuricemia and albuminuria in patients with type 2 diabetes mellitus (T2DM).This study evaluated the association between serum uric acid & urinary albumin to creatinine ratio (ACR) among T2DM patients and also explored the relation between normoalbuminuria (ACR <30ug/ mg), microalbuminuria (ACR between 30µg/mg & 299 µg/mg) & macro albuminuria (ACR ≥ 300ug/mg) with serum uric acid levels.

In a hospital based observational (cross-sectional) study of 100 patients (47 men and 53 women) in the age group of 40-80 years with T2DM, serum uric acid and urinary albumin-creatinine ratio were determined. Other metabolic parameters including lipid profile, glycated hemoglobin (HbA1c), serum creatinine (Cr), glomerular-filtration rate (GFR), body mass index (BMI), blood pressure, fasting plasma glucose (FPG) were assessed as well.

Mean serum uric acid levels for normoalbuminuric, microalbuminuric and macroalbuminuric patients were 4.64 ± 1.07 mg/dL, 6.38 ± 1.3 mg/dL, and 7.68 ± 1.0 mg/dL, respectively. In T2DM patients, hyperuricemia was significantly positively correlated with FPG, HbA1C, Cr, LDL-cholesterol & triglycerides in patients with T2DM (P <0.001). No significant correlation found between hyperuricemia and age, sex, weight, height, BMI, hypertension & HDL-cholesterol. Serum Uric Acid level correlated negatively with GFR. In patientswith T2DM serum uric acid level correlated positively (p<0.001) with urinary ACR. This study showed that hyperuricemia was associated with a greater probability of albuminuria in patients with T2DM.

KEYWORDS: T2DM, hyperuricemia, albuminuria, kidney.

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INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a heterogeneous group of disorders characterized by variable degrees of insulin resistance, impaired insulin secretion, and increased glucose production [1]. Distinct genetic and metabolic defects in insulin action and/or secretion give rise to the common phenotype of hyperglycemia in type 2 DM. In Asia, the prevalence of diabetes is increasing rapidly and the diabetes phenotype appears to be different from that in the United States and Europe - onset at a lower BMI and younger age, greater visceral adiposity, and reduced insulin secretory capacity [2].

In United State, Diabetes Mellitus is the leading cause of End Stage Renal Disease (ESRD) [1]. The number of patients diagnosed each year with ESRD due to Type 2 diabetes mellitus is raising. The complex pathogenesis for the development of diabetic nephropathy is not fully understood. One factor that has been associated with cardio vascular & renal disease is serum uric acid. Recently experimental and clinical studies have suggested that uric acid may contribute to the development of hyper tension, metabolic syndrome &kidney diseases. There is emerging

evidence that hyperuricemia is an independent risk factor for the development of chronic kidney disease, perhaps through endothelial damage[3].

Hyperuricemia is defined as serum uric acid level ≥ 7 mg/dl (in men) or ≥ 6.0 mg/dl (in women)[4]. Uric acid is an end product of purine metabolism, and approximately, one-third of it is degraded in the gut, and two-thirds is excreted by the kidneys [5-7]. Elevated uric acid levels can result from increased generation or decreased elimination. Increased generation, in turn, can be caused by ingesting a purine-rich diet or alcohol, by certain genetic disorders (such as the Lesch-Nyhan syndrome), and by increased turnover of cells (such as in myeloproliferative diseases or tumor lysis syndrome) [7, 8]. On the other hand, decreased renal excretion can be a consequence of decreased glomerular filtration rate (GFR), increased tubular reabsorption induced by volume depletion when using diuretics, or inhibition of renal tubular secretion induced by inhibition of the anion-exchange transport system by lactate or ketoacids [7,8]. Although decreased kidney function can be associated by hyperuricemia [9,10] based on some epidemiological studies, hyperuricemia is an independent risk factor for kidney dysfunction in patients with diabetes mellitus (DM)[10]. It is suggested that increased serum level of uric acid is an injurious factor for kidneys [6], as it is shown that hyperuricemia-induced endothelial dysfunction, glomerular hypertension, and renal hypertrophy decrease renal perfusion via stimulation of the afferent arteriolar vascular smooth muscle cell proliferation [11-15]. In some studies on diabetic patients, it has been reported that hyperuricemia is associated with kidney damage independent of hypertension [6]. On the other hand, higher levels of serum insulin may decrease uric acid clearance by the kidneys [16]. As a rule, hyperinsulinemia is the basis of type 2 DM pathophysiology [16]. Therefore, diabetic patients are more prone to uric acid injury.

Hyperuricemia is an independent risk factor for kidney dysfunction in diabetic patient. On the other hand albuminuria is considered as the predictor of early stages of diabetic nephropathy. We investigated the correlation between hyper- uricemia and albuminuria in patients with Type - 2 Diabetes Mellitus (T_2DM). The aim of this study is to evaluate the association between serum uric acid & urinary Albumin to Creatinine Ratio (ACR) among patients with type 2 diabetes mellitus. Since there is lack of studies in our country regarding the association of hyperuricemia with albuminuria in patients with T2DM, we would like to study the association of hyperuricemia with albuminuria in patients with T2DM. Hence, the primary objective of the study is evaluation of serum uric acid level & urinary Albumin-Creatinine Ratio (ACR) in patients of T2DM in both younger & older age groups (40 to 80 years). As well as to evaluate relation between normo- albuminuria (ACR <30 ug/ mg), micro albuminuria (ACR between 30 ug/mg & 299 ug/mg) &macro albuminuria (ACR ≥ 300ug/mg) with serum uric acid levels.

MATERIALS AND METHODS

Definition of problem

We studied the relationship between serum uric acid level & albuminuria in T_2DM patients.

Defination of population

Patients aged between 40 to 80 years coming to IPGME&R / SSKM Hospital in the General Medicine or other related departments.The patients were selected for study from Medicine OPD and indoor wards.

Study Variable

Age, Body weight, Height, BMI, serum uric acid, urinary albumin to creatinine ratio (ACR), Fasting Blood Glucose (FBG), HbA1C, lipid profile, serum creatinine.

Inclusion Criteria

Type 2 Diabetics Mellitus (T_2DM) patients, Age between 40 to 80 years.

Exclusion Criteria

Patients on uric acid lowering agents, patients using diuretics or any other medication that influences serum uric acid level, patients on angiotensin converting enzyme (ACE) inhibitor or Angiotensin Receptor Blocker (ARB), alcoholic, acute illness, UTI, patients with malignancy and glomerular Filtration Rate (GFR) < 60 ml / min

Sample Size

Total number of cases were 100 (hundred) including both male and female and evaluated to calculate a correlation coefficient between albuminuria as measured by urinary ACR & serum uric acid level.

Sample Design

Patients and their relatives were fully explained by their mother language (Bengali, Hindi) about the study. After getting informed consent from them, patients were included in the study accordingly to the inclusion & exclusion criteria as mentioned previously.

Study Design

Hospital based, Observational Study (Cross Sectional)

Laboratory Investigations

Complete blood count, Serum uric acid, Urine RE/ ME & C/S, Urinary Albumin to Creatinine Ratio (ACR), Fasting Blood Glucose (FBG), HbA1C, Lipid profile, Serum Urea &Creatinine, USG whole abdomen, ECG in all leads [17].

Parameters and procedure

History Taking: Particularly alcohol consumption, use of certain drugs, duration of diabetes mellitus.

Clinical Examination**:**

- Measurement of blood pressure
- Weight was taken in kilogram by standard weighing machine.
- Height was taken in centimetre with the help of stadiometer
- BMI was calculated by standard equation. The equation used is as as follows:-

$$BMI = Weight(Kg)/[Height(Met)^2]$$

- Thorough general survey and systemic evaluation was done

Hematological, Biochemical, Radio logical investigations:

- Haemoglobin, total leucocyte count, differential leucocyte count, platelet count, ESR.
- Fasting blood glucose(FBG), HbA1C. FBG was estimated by GOD / POD (glucose oxydase-peroxydase) method [18].
- Serum urea, creatininine
- Fasting lipid profile: fasting serum total cholesterol, low density lipoprotein cholesterol (LDL), high density lipoprotein cholesterol(HDL), very low density lipoprotein cholesterol (VLDL), triglycerides.
- Estimation of total cholesterol- Total serum cholesterol was estimated by "CHOD – POD" (cholesterol oxydase - peroxydase method) enzymatic photometric test.
- Estimation of HDL – Phosphotungstate / Mg2+ precipitates chylomicrons, LDL, VLDL fractions. HDL fraction remains unaffected in supernatant fluid which is measured by absorbance of light at 510 nm.
- Estimation of triglyceride – by colorimetric enzymatic test using glycerol 3 phosphate oxidase.
- VLDL cholesterol was calculated by the formula triglyceride /5.
- LDL cholesterol – was calculated by the formula: total cholesterol – [triglyceride/5+HDL].
- Urine RE/ ME & C/S
- USG whole abdomen
- ECG in all leads

Specific investigation

Urinary creatinine was measured by colorimetry. Urinary albumin was measured by immunoturbidimetry. Urinary albumin creatinine ratio (ACR)was calculated by dividing the urinary albumin concentration in micrograms by the urinary creatinine concentration in milligrams. Serum uric acid level was measured in standerdisedautoanalyser with appropriate quality control sera.

Other necessary investigations as and when required.GFR was calculated using Cockroft-Gault formula [17]. Types 2 diabites mellitus diagnosed based on World Health Organization criteria. Patients enrolled in the study were recommended not to have heavy excersise 24 hours before examination. Urine sample consisted of mid stream urine spot test. Blood samples were collected after 10 hours of fasting.

RESULTS AND ANALYSIS

In this study, a total of 100 patients of Type 2 Diabetes Mellitus patients in the age group of 40-80 yrs were selected according to the inclusion criteria. All the patients were subjected to detailed history taking, clinical examination and different investigations with special emphasis on serum uric acid & spot urinary ACR. Collected data were analyzed using suitable statistical methods and interpreted in the following manner.

There is stastically significant relation between mean of FBG, HbA1C, serum Creatinine, GFR & serum Uric Acid with different Albuminuria groups in study population. Microalbuminuria & Macroalbuminuria related positively with mean of FBG,HbA1C,serumCreatinine& serum Uric Acid and related negatively with mean eGFR.Mean urinary ACR in Normoalbuminuria, Microalbuminuria & Macroalbuminuria are 22.28±4.09,134.79±70.65 and 469.83±120.14 respectively [19].

There is strong positive correlation of serum Uric Acid,FBG,HbA1C,serumcreatinine with urinary ACR. But there is strong negative correlation between GFR & urinary ACR. In female population with Normoalbuminuria 79.2% (n=19) have Normouricemia & 20.8% (n=5) have Hyperuricemia.

In female population with Microalbuminuria 40% (n=8) have Normouricemia& 60% (n=12) have Hyperuricemia. In female population with Macroalbuminuria 22.2% (n=2) have Normouricemia & 77.8% (n=7) have Hyperuricemia. So there is stastically significant association between Hyperuricemia and Albuminuria in Female population.

In male population with Normoalbuminuria 96% (n=24) have Normouricemia & 4% (n=1) have Hyperuricemia. In male population with Microalbuminuria 16.7% (n=2) have Normouricemia& 83.3% (n=10) have Hyperuricemia. In male population with Macroalbuminuria10% (n=1) have Normouricemia & 90% (n=9) have Hyperuricemia. So there is stastically significant association between Hyperuricemia and Albuminuria in Male population [20].

REGRESSION ANALYSIS

Regression analysis was performed with Urinary ACR as the dependent variable and Serum Uric acid as the independent variable. The R Square was 0.455 i.e. 45.5% of variation in Urinary ACR can be explained by Serum Uric acid. Serum Uric acid has a significant positive impact on Urinary ACR (parameter estimate 73.2 and p value < 0.001.

Multiple Regression analysis was performed with Urinary ACR as the dependent variable and Serum Uric

acid, Hypertensive (Binary variable), GFR, Serum Creatinine, FBG, HbA1C, TG, LDL, HDL & BMI as the independent variables. The R Square was 0.719 i.e. 71.9% of variation in Urinary ACR can be explained by these variables together. However, only Serum Uric acid & FBG have a significant positive impact on Urinary ACR (parameter estimates 24.482 and and 2.048 with p value 0.010 and < 0.001).

Table 1. Sex distribution of study population in different albuminuria groups

	Albuminuria				
Sex	Normo Albuminuria	Micro + Macro Albuminuria	Total	P Value	Significance
FEMALE	24(49)	29(56.9)	53(53)	0.430	Not Significant
MALE	25(51)	22(43.1)	47(47)		
	49(100)	51(100)	100(100)		

In patients with normoalbuminuria49%(n=24) are female & 51%(n=25) are male.
In patients with albuminuria(micro + macro) 56.9%(n=29) are female & 43.1% are male.

Table 2. Sex distribution of study population in normouricemia&hyperuricemia group:

	Serum uric acid				
Sex	NormoUrecimia	Hyper Urecimia	Total	P Value	Significance
FEMALE	29(51.8)	24(54.5)	53(53)	0.784	Not Significant
MALE	27(48.2)	20(45.5)	47(47)		
Total	56(100)	44(100)	100(100)		

Table 3.Distrbution of mean Age, Weight, Height& BMI among different Albuminuria groups in study population

	Albuminuria			
	Normo Albuminuria	Micro + Macro Albuminuria		
	Mean ± Std. Deviation	Mean ± Std. Deviation	P Value	Significance
Age	56.35 ± 8.65	56.8 ± 10.94	0.818	Not Significant
Weight	62.96 ± 7.17	64.2 ± 7.45	0.400	Not Significant
Height	157.61 ± 7.25	159.43 ± 7.2	0.211	Not Significant
BMI	25.33 ± 2.16	25.23 ± 2.16	0.820	Not Significant

There is no stastically significant relationship found between Albuminuria with mean age, weight, height & BMI in study population.

Table 4.The BMI of study population is divided into three group(<25, ≥25to<30, ≥30).

	Albuminuria					
BMI	Normo Albuminuria	Micro Albuminuria	Macro Albuminuria	Total	P Value	Significance
<25	21(42.9)	17(53.1)	7(36.8)	45(45)	0.372	Not Significant
≥25 to <30	26(53.1)	15(46.9)	10(52.6)	51(51)		
≥30	2(4.1)	0(0)	2(10.5)	4(4)		
Total	49(100)	32(100)	19(100)	100(100)		

There is no significant relation found between Albuminuria and different BMI groups in study population.

Table 5. Relation of different BMI groups with Normouricemia &Hyperuricemia in Study population

	Serum uric acid				
BMI	NormoUrecimia	Hyper Urecimia	Total	P Value	Significance
<25	23(41.1)	22(50)	45(45)	0.230	Not Significant
≥25 to <30	32(57.1)	19(43.2)	51(51)		
≥30	1(1.8)	3(6.8)	4(4)		
Total	56(100)	44(100)	100(100)		

Table 6. Age, Weight, Height& BMI distribution in study population in relation to Normouricemia&Hyperuricemia:

	Serum uric acid			
	NormoUrecimia	Hyper Urecimia		
	Mean ± Std. Deviation	Mean ± Std. Deviation	P Value	Significance
Age	56.75 ± 9.74	56.36 ± 10.08	0.847	Not Significant
Weight	63.27 ± 6.63	64 ± 8.14	0.621	Not Significant

Height	158.21 ± 6.81	158.95 ± 7.82	0.614	Not Significant
BMI	25.26 ± 1.95	25.3 ± 2.4	0.923	Not Significant

Table 7. Relation of Hypertension with different albuminuria groups in study population: Not significant

	Albuminuria					
	Normo Albuminuria	Micro Albuminuria	Macro Albuminuria	Total	P Value	Significance
Hypertensive	20(40.8)	14(43.8)	12(63.2)	46(46)	0.241	Not Significant
Normotensive	29(59.2)	18(56.2)	7(36.8)	54(54)		
Total	49(100)	32(100)	19(100)	100(100)		

Table 8. Relation of Hypertension with Hyperuricemia & Normouricemia groups in study population: Not significant

	Serum uric acid				
	NormoUrecimia	Hyper Urecimia	Total	P Value	Significance
Hypertensive	22(39.3)	24(54.5)	46(46)	0.129	Not Significant
Normotensive	34(60.7)	20(45.5)	54(54)		
Total	56(100)	44(100)	100(100)		

Table 9. Relation of HbA1C with Albuminuria in study population

	Albuminuria				
HbA1C	Normo Albuminuria	Micro + Macro Albuminuria	Total	P Value	Significance
<7%	48(98)	10(19.6)	58(58)	<0.001	Significant
≥7%	1(2)	41(80.4)	42(42)		
Total	49(100)	51(100)	100(100)		

People with Normo albuminuria have higher proportion of patients with HbA1C < 7%.People with Albuminuria(Micro+Macro) have higher proportion of patients with HbA1C>=7%

Table10. Distribution of mean Triglycerides(TG),LDL &HDL in relation to different groups of Albuminuria in study population

	Albuminuria				
	Normo Albuminuria	Micro Albuminuria	Macro Albuminuria		
	Mean ± Std. Deviation	Mean ± Std. Deviation	Mean ± Std. Deviation	P Value	Significance
TG	119.57 ± 25.33	127.62 ± 24.49	154.68 ± 24.69	<0.001	Significant
LDL	121.8 ± 22.45	127.97 ± 22.37	151.05 ± 13.58	<0.001	Significant
HDL	47.43 ± 5.88	48.22 ± 5.39	45 ± 6.51	0.160	Not Significant

Albuminuria correlated positively with increased level of TG & LDL but no such relation seen with HDL.

Table 11.Distribution of mean Triglycerides(TG),LDL &HDL in relation to Normouricemia&Hyperuricemia in study population

	Serum Uric Acid			
	NormoUrecimia	Hyper Urecimia		
	Mean ± Std. Deviation	Mean ± Std. Deviation	P Value	Significance
TG	119.84 ± 23.66	140.25 ± 29.03	<0.001	Significant
LDL	122 ± 21.45	138.66 ± 22.97	<0.001	Significant
HDL	47.84 ± 5.91	46.43 ± 5.86	0.238	Not Significant

Serum Uric Acid correlated positively with increased level of TG & LDL but no such relation seen with HDL.

Table 12. Distribution of mean FBG,HbA1C,serum Creatinine ,GFR,Urinary ACR & serum Uric Acid among different Albuminuria groups in study population:

	Albuminuria				
	Normo Albuminuria	Micro Albuminuria	Macro Albuminuria		
	Mean ± Std. Deviation	Mean ± Std. Deviation	Mean ± Std. Deviation	P Value	Significance
FBG	115.43 ± 19.43	184.47 ± 33.56	233.11 ± 53.95	<0.001	Significant
HbA1C	6.03 ± 0.48	7.47 ± 0.72	8.53 ± 1.3	<0.001	Significant

Serum Creatinine	0.79 ± 0.15	0.92 ± 0.23	1.04 ± 0.2	<0.001	Significant
GFR	86.2 ± 11.11	75.04 ± 8.85	64.91 ± 5.43	<0.001	Significant
Urinary ACR	22.28 ± 4.09	134.79 ± 70.65	469.83 ± 120.14	<0.001	Significant
Serum Uric Acid	4.64 ± 1.07	6.38 ± 1.3	7.68 ± 1	<0.001	Significant

Table 13. Distribution of mean FBG, HbA_1C, serum Creatinine, GFR, Urinary ACR & serum Uric Acid among Normouricemia&Hyperuricemia groups in study population

	Serum uric acid			
	NormoUrecimia	Hyper Urecimia		
	Mean ± Std. Deviation	Mean ± Std. Deviation	P Value	Significance
FBG	130.84 ± 42.56	196.84 ± 52.06	<0.001	Significant
HbA1C	6.31 ± 0.86	7.81 ± 1.17	<0.001	Significant
Serum Creatinine	0.82 ± 0.18	0.96 ± 0.21	<0.001	Significant
GFR	83.74 ± 11.99	72.02 ± 10.11	<0.001	Significant
Urinary ACR	59.99 ± 101.05	249.38 ± 199.75	<0.001	Significant
Serum Uric Acid	4.54 ± 0.93	7.35 ± 0.76	<0.001	Significant

Table 14. Correlation of Urinary ACR with serum Uric Acid, FBG, HbA_1C, Serum Creatinine, GFR

Correlations		
		Urinary ACR
Sr.Uric Acid	Pearson Correlation	0.675
	p Value	<0.001
FBG	Pearson Correlation	0.794
	p Value	<0.001
HbA1C	Pearson Correlation	0.771
	p Value	<0.001
Serum Creatinine	Pearson Correlation	0.489
	p Value	<0.001
GFR	Pearson Correlation	-0.627
	p Value	<0.001

Table 15. Regression

Model Summary				
	R	R Square	Adjusted R Square	Std. Error of the Estimate
	0.675[a]	0.455	0.450	132.560
a. Predictors: (Constant), Sr.Uric Acid				

Coefficients[a]						
		Unstandardized Coefficients		Standardized Coefficients	t	P Value
		B	Std. Error	Beta		
	(Constant)	-279.556	48.574		-5.755	<0.001
	Sr.Uric Acid	73.200	8.089	0.675	9.049	<0.001
a. Dependent Variable: Urinary ACR						

Table 16. Multiple regression analysis

Model Summary				
l	R	R Square	Adjusted R Square	Std. Error of the Estimate
	0.848[a]	0.719	0.688	99.831
a. Predictors: (Constant), BMI, Sr.Uric Acid, Hypertensive, HDL, TG, Serum Creatinine, HbA1C, GFR, LDL, FBG				

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	P Value
		B	Std. Error	Beta		
1	(Constant)	-389.351	247.278		-1.575	0.119
	Sr.Uric Acid	24.482	9.309	0.226	2.630	0.010
	Hypertensive	-34.297	23.669	-0.096	-1.449	0.151
	GFR	-2.266	1.170	-0.160	-1.937	0.056

	Serum Creatinine	44.984	67.639	0.053	0.665	0.508
	FBG	2.048	0.350	0.655	5.853	<0.001
	HbA1C	-67.540	38.457	-0.187	-1.756	0.082
	TG	.371	0.530	0.058	0.699	0.486
	LDL	.399	0.676	0.053	0.590	0.557
	HDL	1.697	2.012	0.056	0.843	0.401
	BMI	5.320	5.083	0.064	1.047	0.298
a. Dependent Variable: Urinary ACR						

DISCUSSION

This study is a hospital-based, observational (cross-sectional) study to evaluate serum uric acid level & urinary Albumin Creatinine Ratio(ACR) in patients of T2DM in both younger & older age group (40 to 80 years). The study also Evaluate relation between normo albuminuria (ACR <30 ug/ mg), micro albuminuria (ACR between 30 ug/mg & 299 ug/mg) & macro albuminuria (ACR ≥ 300ug/mg) with serum uric acid levels. Although we have contemplated a study both in younger & older age group but eventually this was not done as the number of T2DM patients in younger age group was inadequate and those who are younger than 40 years were excluded.

A total of 100 patients in the age group of 40-80 yrs with T2DM who satisfied the inclusion criteria were selected.

DEMOGRAPHUC PROFILE

Mean age in the study population was 56.6±9.84 years (Maximum-80 years, Minimum-40). Chin-Hsiao Tseng *et al* reported that mean age in study population was 62.8±10.8 years.

Bonakdaran S, Hami M *et al* showed mean age in the study population was 52.45±10.11 years.

In study population 47% (n=47) were Male & 53% (n=53) were Female. The slightly increased number of females could be explained by the fact that women come more to the health care set up. Another cause may be that our study was hospital based not population based and the disorder (T2DM) is more common in women [21].

Chin-Hsiao Tseng *et al* reported that in study population 42% were Male & 58% were Female. Bonakdaran S, Hami M *et al* reported that in study population 43.53% were Male&56.47% were Female.

Mean BMI in patients with T2DM in study population was 25.3 ±2.15kg/m^2 (Maximum-31.2 kg/m^2, Minimum-21.1 kg/m^2). Chin-Hsiao Tseng *et al* reported that in study population mean BMI was 24.6±3.5 kg/ m^2.

Bonakdaran S, Hami M *et al* reported that in study population mean BMI was 28.24±4.42 kg/m^2. The difference in the BMI with our study is probably due the Indian population inclusion in our study.

The mean of the FBG in patients with T2DM in study population was 159.9 ± 57.16 mg/dl (maximum=335 mg/dl, minimum= 86 mg/dl).

Chin-Hsiao Tseng *et al* reported that the mean of the FBG in patients with T2DM in study population was 152.1 ± 49.3 mg/dl. Bonakdaran S, Hami M observed that the mean of the FBG in patients with T2DM in study population was 191.32 ± 66.25 mg/dl.

The mean of the HbA1C in patients with T2DM in study population was 7.0 ± 1.25% (maximum=11.4%, minimum= 5.4%). Bonakdaran S, Hami M *et al* observed that the mean of the HbA1C in patients with T2DM in study population was 8.68 ± 1.96%. The high mean HbA1C may due the poor glycemic control in patients included in this study.

The mean of the serum Creatinine in patients with T2DM in our study population was 0.90 ± 0.21 mg/dl (maximum=1.6 mg/dl, minimum= 0.5 mg/dl). Bonakdaran S, Hami M *et al* observed that the mean of the serum Creatinine in patients with T2DM in study population was 0.95 ± 0.32mg/dl.

The mean of the GFR in patients with T2DM in study population was 78.6±12.59 ml/min (maximum=121.4ml/min, minimum= 60.5ml/min). Chin-Hsiao Tseng *et al* reported that the mean of the GFR in patients with T2DM in study population was 63.4 ± 27.9 ml/min.

Bonakdaran S, Hami M *et al* observed that the mean of the GFR in patients with T2DM in study population was 102.68 ± 35.52 ml/min. The mean of the (Triglycerides) TG in patients with T2DM in our study population was 128.8 ± 27.94 mg/dl (maximum=199 mg/dl, minimum= 84 mg/dl).

Chin-Hsiao Tseng *et al* reported that the mean of the TG in patients with T2DM in study population was 173.9 ± 117.3 mg/dl. Bonakdaran S, Hami M *et al* observed that the mean of the TG in patients with T2DM in study population was 202.02 ± 130.10 mg/dl.

The mean of the LDL in patients with T2DM in our study population was 129.3 ± 23.54 mg/dl (maximum=186 mg/dl, minimum= 84 mg/dl). Bonakdaran S, Hami M *et al* observed that the mean of the TG in patients with T2DM in study population was 127.50 ± 33.07 mg/dl.

The mean of the HDL in patients with T2DM in our study population was 47.2 ± 5.90 mg/dl (maximum=57 mg/dl, minimum= 36 mg/dl). Bonakdaran S, Hami M *et al* observed that the mean of the HDL in patients with T2DM in study population was 43.05 ± 9.82 mg/dl.

Serum Uric Acid level in the study

The mean of the serum Uric Acid in patients with T2DM in our study population was 5.8 ± 1.65 mg/dl (maximum=8.8 mg/dl, minimum= 3.2mg/dl). Chin-Hsiao Tseng *et al* reported that the mean of the Uric Acid in patients with T2DM in study population was 5.6 ± 1.9 mg/dl.

Bonakdaran S, Hami M *et al* observed that the mean of the serum Uric Acid in patients with T2DM in study population was 5.55 ± 1.47 mg/dl. Mean serum Uric Acid levels in patients with T2DM in our study population for normoalbuminuric, microalbuminuric, and macroalbuminuric patients were 4.64 ± 1.07 mg/dL, 6.38± 1.3 mg/dL, and 7.68 ± 1.0 mg/dL respectively.

Chin-Hsiao Tseng *et al* reported that the mean serum Uric Acid levels in patients with T2DM in study population for normoalbuminuric, microalbuminuric, and macroalbuminuric patients were 5.2 ± 1.6 mg/dL, 5.6± 1.9 mg/dL, and 6.7 ± 2.1 mg/dL respectively.

Bonakdaran S, HamiM *et al* observed that the mean serum Uric Acid levels in patients with T2DM in study population for normoalbuminuric, microalbuminuric, and macroalbuminuric patients were 4.49 ± 1.22 mg/dL, 4.84± 1.52 mg/dL, and 6.15 ± 1.68 mg/dL respectively.

Urinary ACR in the study

Mean urinary ACR levels in patients with T2DM in our study population for normouricemic & hyperurecimic patients were 59.99±101.05 µg/mg, and 249.38±199.75 µg/mg, Mean urinary ACR levels in patients with T2DM in our study population for normoalbuminuric, microalbuminuric, and macroalbuminuric patients were 22.28 ± 4.09 µg/mg, 134.79±70.65 µg/mg, and 469.83 ± 120.14µg/mg respectively.

Bonakdaran S, Hami M *et al* observed thatthe mean urinary ACR in patients with T2DM in study population was 32.52±54.96µg/mg.

Relation of serum Uric Acid level with urinary ACR

There is significant correlation between serum Uric acid & urinary ACR in our study.Pearson correlation coefficient r =0.675(P value <0.001).Spearman's coefficient of rank correlation (rho) =0.731(P value <0.001).

Chin-Hsiao Tseng *et al* reported that their is significant correlation between serum Uric Acid & urinary ACR. Pearson correlation coefficient r between serum uric acid & natural logarithmic urinary ACR =0.168(P value <0.05).

BonakdaranS, HamiM *et al* observed that their is significant correlation between serum Uric Acid & urinary ACR. Pearson correlation coefficient r between serum uric acid & urinary ACR =0.097(P value <0.05).

CONCLUSION

Hyperuricemia correlated positively with FBG, HbA1C, serum creatinine, LDL & Triglycerides in patients with T2DM .No significant correlation found between Hyperuricemia and Age, Sex, Weight, Height, BMI, Hypertension & HDL.

Urinary ACR correlated positively with FBG, HbA1C, serum creatinine, LDL& Triglycerides in patients with T2DM.No significant correlation found between urinary ACR and Age, Sex, Weight, Height, BMI, Hypertension &HDL. In patients with T2DM serum Uric Acid level correlated negatively with GFR.

In patients with T2DM serum uric acid level correlated positively with urinary albumin creatinine ratio. This study showed that Hyperuricemia was associated with a greater probability of Albuminuria in patients with type 2 diabetes mellitus. Serum uric acid is an independent correlate of urinary ACR in patients with type 2 diabetes mellitus.

STUDY DESIGN

This was a cross-sectional study where serum uric acid & urinary ACR level were assessed single time. A longitudinal study with baseline and follow up of serum uric acid & urinary ACR in T2DM patients would have been more suited to determine the relationship between the occurrence of albuminuria and hyperuricemia.

SELECTION BIAS

The study being a hospital-based study, there is always a chance of selection bias and the subjects might not be the ideal representative of the population.

SAMPLE SIZE

A larger number of study populations would have made this study more accurate and lended further weightage to the results. 100 patients is too small to come into a conclusion.

STUDY IN NON DIABRTIC SUBJECT

The validity to extrapolate the relationship between uric acid and urinary ACR to nondiabetic subjects requires confirmation

REFERRAL BIAS

Referral bias could not be excluded because the study conducted in tertiary care hospital like our institution .This may influence the study result in this study.

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Nil

CONFLICT OF INTEREST

No interest

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