RELATIONSHIP BETWEEN FASTING BLOOD GLUCOSE, SERUM UREA, SERUM CREATININE AND DURATION OF DIABETES IN TYPE-2 DIABETIC PATIENTS

K.P. MISHRA, ALOK MAWAR, PAWAN K. KARE AND NISHA VERMA

Department of Biochemistry,

Sarojani Naidu Medical College,

AGRA, (U.P.) INDIA

Email: - pawankare4@gmail.com

ABSTRACT

In the present case control study, fasting blood glucose, serum urea and serum creatinine levels were measured in 50 diagnosed cases of type-2 DM patients and 50 age and sex matched healthy controls of North Indian Agra population. The fasting blood glucose level, serum urea and serum creatinine were significantly ($p<0.001$) increased with the increasing duration of diabetes. Our findings have shown that the renal function tests including serum urea and serum creatinine levels could be used for assessment of renal impairment in diabetic patients. The measurement of these tests would be a beneficial effect on renal complications and may be progression of diabetic nephropathy. Good glycemic control is also required in diabetic patients with increasing duration to prevent the renal dysfunction.

Introduction

Diabetes Mellitus is chronic metabolic disorder that can lead to various vascular complications like cardiovascular, renal, neurological, and retinal complication[7,14]. Diabetes mellitus associated with dyslipidemia, hypertension and visceral adiposity, which collectively increase risk of developing chronic kidney disease[18]. To increase prevalence, progression and complications of chronic kidney disease is due to a progressively aging, population, duration of diabetes and presence of hypertension[10]. About one third of type 2 diabetics will eventually have progressive deterioration of renal function[12]. Diabetic nephropathy is a public health concern of increasing proportions. It has become the most common single cause of end-stage renal disease all over the world[9]. In diabetes, the cell unable to receive glucose and most of it is accumulated in the blood which can lead to heart disease and damage to the nerves and kidneys[5]. When blood sugar is increased, it induces stress on kidneys and damage to the blood vessels, leading to kidney disease. The kidneys excrete metabolic waste products and regulate the serum concentration of a variety of substances. At the stage of renal disease, these substances often become abnormal and the extent of the abnormality depends on the severity of the disease. Serum creatinine and urea concentrations change inversely with changes in GFR so these are useful to detect the degree of renal dysfunction[13]. Urea & creatinine are useful parameters for functioning of the kidney. Changes in serum creatinine concentrations more reliably reflect changes in GFR than serum urea concentrations[4]. Several studies reported the relationship between blood glucose, serum creatinine and serum urea levels in type 2 diabetic patients. However, few studies have provided information on the relation between fasting blood glucose, serum urea and serum creatinine levels with duration of diabetes in type 2 diabetic patients. Therefore, the aim of this study was to assess the relationship between fasting blood glucose, serum urea and serum creatinine levels and duration of diabetes in type 2 diabetic patients of North Indian Agra population.

Material and Methods

The study was carried out in the Department

TABLE -1: Demographic data of healthy controls and diabetic patients

Parameter	Healthy controls(n=50)	Diabetic patients(n=50)
Male Female	n=30 n=20	n=28 n=22
Rural Urban	n=15 n=35	n=10 n=40
Age (30-65 years)	48±9.0	53±9.3
Weight (kg)	64± 9.5	62 ±8.8
Height (cm)	165.9 ± 10.6	163.8 ± 9.9
BMI (kg/m$^{2)}$	23 ± 0.9	25 ± 3.2
Duration of diabetes(years)	-	(0-20years) 5.8 ± 3.7

Values are presented as Mean±SD.

of Biochemistry, Sarojani Naidu Medical College and Hospital, Agra (U.P) during January 2012 to August 2012. Total 100 subjects were selected and divided into two groups. Group I included 50 diagnosed cases with Type-2 DM and 50 age and sex matched healthy controls. They were recruited for the study after taking their due written consent. The diagnosis of Type-2 DM was according to the WHO definition: those having fasting plasma glucose >7.0 mmol/l (126 mg/dl) or taking anti-diabetic medications. The subjects were in the age group of 35 to 65 years both male and female.

Blood samples were drawn in NaF and Plain tubes from the antecubital vein in the morning after an overnight fast. Serum was separated from blood by centrifugation at 3000 rpm for 10 minutes. Fasting blood glucose, serum urea and serum creatinine determined immediately. The study was approved by the Institutional Ethical Committee of Sarojani Naidu Medical College and Hospital, Agra, U.P.

Fasting blood glucose was estimated by GOD-POD enzymatic method by using spectrophotometer (Systronics).

Glycosylated hemoglobin was measured by the method of resin ion exchange method.

Estimation of serum urea was done by DAM colorimetric method.

Serum creatinine was estimated by alkaline

TABLE-2 : Fasting blood glucose, serum urea and serum creatinine levels in healthy controls and diabetic patients.

	Healthy controls(n=50)	Diabetic patients(n=50)	p-value	Significance level
Fasting blood glucose(mg/dl)	80 ± 7.0	154± 67.4	p<0.001	HS
Serum urea(mg /dl)	29.8 ± 5.8	39.3 ± 7.9	P<0.001	HS
Serum creatinine (mg /dl)	0.9 ±0.2	1.2 ± 0.3	p<0.01	MS

HS= highly significant, MS= moderately significant

TABLE-3: Comparison of fasting blood glucose, serum urea and serum creatinine levels in healthy control male and diabetic male patients.

	Healthy control male (n=30)	Diabetic male patients (n=28)	p-value	Significance level
Fasting blood glucose (mg/ dl)	78 ±6.4	148± 69.7	p<0.001	HS
Serum urea(mg /dl)	30.8 ±5.8	37.8 ± 7.3	p<0.001	HS
Serum creatinine(mg /dl)	0.9 ±0.2	1.1 ± 0.23	p<0.001	HS

HS= highly significant

picrate jaffe's kinetic method.

Statistical analysis was performed with the SPSS-16 software. All the values were expressed as Mean ±SD. Student "t" test was used to assess statistical significance of the results. P value d"0.05 was used as a threshold of significance.

Result

The demographic characteristics of the subjects under study are presented in (Table -1). 100 subjects were selected in the present study. Out of 100 subjects, 50 volunteers (30 males and 20 females) were in healthy control group, in which 15 belonged to rural area and 35 belonged to urban area. Other 50 subjects (28 males and 22 females) were in diabetic group. Out of these, 40 subjects belonged to urban area and only 10 subjects from rural area. The mean age of control subjects was 48 ± 9.0 years while in diabetic patients it was 53 ± 9.3 years. The mean value of body mass index (BMI) of diabetic patients (24 ± 3.2 kg/m^2) was significantly higher as compared to that of control subjects (23± 0.9 kg/m^2). Mean duration of diabetes in the present study was 5.8 ± 3.7 years.

In healthy control group, mean fasting blood glucose, serum urea and serum creatinine levels were 79.9± 7.0 mg/ dl (range 70-97 mg/ dl), 29.8 ± 5.8 mg/dl (range 22-39 mg/ dl) and 0.9±0.2mg/dl (range 0.69-1.3mg/dl) respectively. In diabetic patients group, mean fasting blood glucose, serum urea and serum creatinine were 154±67.4 mg/ dl (range 73-297 mg/ dl), 39.29±8.2mg/dl (range 23.06-52 mg/ dl), 1.2±0.3 mg/dl (range 0.65-1.9mg/ dl) respectively. The levels of fasting blood glucose,

TABLE-4: Comparison of fasting blood glucose, serum urea and serum creatinine levels in healthy controls and diabetic female patients.

	Healthy control female (n=20)	Diabetic female patients(n=22)	p-value	Significance level
Fasting blood glucose(mg/ dl)	82 ±7.6	161 ±65.7	p<0.001	HS
Serum urea(mg /dl)	28.3 ±5.6	41.25 ± 9.2	P<0.001	NS
Serum creatinine (mg /dl)	1.02 ±0.2	1.1 ± 0.3	p>0.05	NS

HS=highly significant, NS= non significant

TABLE-5: Comparison of fasting blood glucose, serum urea and serum creatinine levels in male and female diabetic patients

	Diabetic male patients (n=23)	Diabetic female patients (n=22)	p-value	Significance level
Fasting blood glucose(mg/ dl)	148± 69.7	161 ±65.7	p>0.05	NS
Serum urea (mg/ dl)	37.8 ±7.3	41.25 ±9.2	p>0.05	NS
Serum creatinine (mg/ dl)	1.1 ± 0.23	1.1 ± 0.3	p>0.05	NS
NS= non significant				

serum urea and serum creatinine were significantly increased in diabetic patients as compared to healthy control. (Table-2)

In 30 males of healthy control group fasting blood glucose, serum urea and serum creatinine were 78.3±6.4 mg/dl (range 70-95 mg/dl), 30.8±5.8 mg/dl (range 22-39 mg/dl) and 0.9±0.2 mg/dl (range 0.69-1.3mg/dl) respectively while in diabetic male (n=23), the values for fasting blood glucose, serum urea and serum creatinine were 148.4±69.7 mg/dl (range 73-282.7 mg/dl), 37.8±7.3 mg/dl (range 27.16-48mg/dl) and 1.2±0.23 mg/dl (range 0.65-1.71mg/dl) respectively. The levels of fasting blood glucose, serum urea and serum creatinine were significantly higher (p<0.001) in diabetic male patients as compared to healthy control males. (Table-3)

In 20 female individuals of healthy control group fasting blood glucose, serum urea and serum creatinine were 81.8±7.6 mg/dl (range70-97 mg/dl), 28.3±5.6 mg/dl (range 22-38mg/dl) and 1.02±0.2 mg/dl (range 0.8-1.3mg/dl) respectively while in diabetic female patients (n=17), the mean values for fasting blood glucose, serum urea and serum creatinine were 160.8±65.7mg/dl (range 82.7-297 mg/dl), 41.25±9.2 mg/dl (range 23.06-52mg/dl) and 1.1±0.3 mg/dl (range 0.69-1.71mg/dl) respectively. The levels of fasting blood glucose, serum urea and serum creatinine were significantly increased (p<0.001) in diabetic female patients as compared to healthy control female while the level of serum creatinine in diabetic female did not change significantly.(Table-4)

In the present study it was found that there was no significant change in fasting blood glucose,

serum urea and serum creatinine levels between male diabetic patients and female diabetic patients. (Table-5)

Fasting blood glucose, serum urea and serum creatinine levels were significantly increased with increasing duration of diabetes in diabetic patients. In 0-1 years group; fasting blood glucose and serum urea levels were significantly increased respectively, 111.14 ± 25.2 mg/dl (p<0.05) and 39.28 ± 7.4mg/dl (p<0.05) as compared to healthy control while serum creatinine level did not change significantly (p>0.05) in 0-1 years group. In 2-5 years group; fasting blood glucose, serum urea and serum creatinine levels were significantly increased respectively, 134.23±45.2 mg/dl (p<0.001), 38.23 ± 8.2 mg/dl (p<0.001) and 1.07 ± 0.24 mg/dl (p<0.05), as compared to healthy control. In above 5 years of diabetic duration group; fasting blood glucose, serum urea and serum creatinine levels were significantly increased respectively, 186.8± 81.2mg/dl (p<0.001), 41.59 ± 8.9 mg/dl (p<0.001) and 1.3 ± 0.32 mg/dl (p<0.001), as compared to healthy control. (Table-6)

Discussion

In the present study, we analyzed the fasting blood glucose, serum urea and serum creatinine level in type 2 diabetic patients in North Indian Agra population. In our study we observed an increase in levels of fasting blood glucose, serum urea and serum creatinine in type 2 diabetic patients when compared with healthy controls. In addition to increased blood glucose level in type 2 diabetic patients, serum urea and serum creatinine levels also significantly increased in male and female

TABLE-6: Fasting blood glucose, serum urea and serum creatinine levels in diabetic patients with increasing duration of diabetes.

	Control Mean± SD	Duration of diabetes		
		0-1yrs Mean± SD	2-5 yrs Mean± SD	>5 yrs Mean± SD
Fasting blood glucose(mg/ dl)	80 ± 7.0	111± 25.2*	134±45.2***	187±81.2***
Serum urea (mg /dl)	29.8 ±5.8	39.28±7.4*	38.23± 8.2***	41.59± 8.9***
Serum creatinine (mg /dl)	0.9 ±0.2	1.05 ± 0.38	1.07 ± 0.24*	1.3 ± 0.32***
***p<0.001, **p<0.01,* p<0.05, p>0.05(NS: without star)				

diabetics compared with their levels in healthy non-diabetic male and female. There was no significant difference in the serum creatinine level between diabetic female compared to healthy control females. It may be due to inadequate number of female diabetic patients. We also found an increase in fasting blood glucose, serum urea and serum creatinine levels with increasing duration of diabetes. There was a significant increase in levels of fasting blood glucose, serum urea and serum creatinine in diabetic patients as compared to healthy controls[3]. The findings of this study were close to our study[13]. In addition, a worker reported in their study on the blood glucose and creatinine levels in male and female type 2 diabetic patients and found that blood glucose and serum creatinine concentrations were increased in type 2 diabetic patients compared with non-diabetic male and female controls[17]. Experimental reports have shown that increased serum creatinine and urea in diabetic rats indicates progressive renal dysfunction[1]. Increased serum creatinine and blood urea levels in type 2 diabetic patients could be attributed to reduce filtering capacity of the kidney thus leading to accumulation of waste products[15]. Impaired function of the nephron in diabetic patients causes high serum creatinine level[6]. Diabetes mellitus is a slow progressive disease characterized by hyperglycemia. Over time high blood sugar level damage millions of nephron tiny filtering units in with each kidney[8]. An increase in serum creatinine

and serum urea occurs when there is damage to the kidney or the kidney is not functioning properly. Increase in serum creatinine and serum urea levels with the increase of fasting blood sugar levels clearly indicate that the increased fasting blood sugar levels cause renal dysfunction[2]. Good control of fasting blood glucose level is absolute requirement to prevent progressive renal impairment[3]. Creatinine is anhydrous form of creatine form in muscles and enters blood, from where it is eliminated by kidneys. If the kidneys are unable to function normally, the serum creatinine increases abnormally. Serum creatinine and urea are well established markers for measurement of Glomerular Filtration Rate (GFR)[16]. Creatinine is a perfect filtration marker and more sensitive index of kidney function compared to blood urea level[11]. Based on our data, it is possible that estimation of serum urea, serum creatinine could be beneficial for assessment of renal dysfunction in diabetic patients.

In our study fasting blood glucose level, serum urea and serum creatinine in diabetic patients were significantly increased with increasing duration of diabetes which showed that increase in duration of diabetes was the risk factor for the kidney damage progression. Serum urea and serum creatinine are widely accepted to assess the renal functions. Increase in duration and poor glycemic control affects the renal functions and lead to renal impairment in diabetic patients.

References

1. ANJANEYULU, MURAGUNDLA; CHOPRA AND KANWALJIT QUERCETIN (2004) An anti-oxidant bioflavonoid, attenuates diabetic nephropathy in rats. *Clinical & Experimental Pharmacology & Physiology*. **31**: 244-8.

2. ANJANEYULU, MURAGUNDLA, CHOPRA AND KANWALJIT, QUECETIN (2004) An anti-oxidant bioflavonoid attenuates diabetic nephropathy in rats. *Clinical & Experimental pharmacology & physiology.* **31**: 244-248*.

3. DEEP A.K., MANJUNATHA GOUD B.K., OINAM SARSINA DEVI., DEVAKI R.N., BHAVANA NAYAL., ASHA PRABHU. AND NAUREEN ANWAR. (2011) *Int J Pharm. Bio.Sci.* **1**: 297-283.

4. GRIFFIN, K.A., KRAMER, H. AND BIDANI, A.K. (2008) Adverse renal consequences of obesity. *Am. J. Physiol. Renal Physiol.* **294**: F685-F696.

5. HOFSO, D., JENSSEN, T., BOLLERSLEV, J., ROISLIEN, J., HAGER, H. AND HJELMESAETH, J. (2009) Anthropometric characteristics and type 2 diabetes in extremely obese Caucasian subjects: a cross-sectional study. *Diabetes Res Clin Pr.* **86**: E9-11.

6. JUDYKAY, T. (2007) Nutrition for reducing urea and creatinine in the blood. *Diabetes care.* **27**: 2191-2192.

7. KHAWAJA, AK., RAFIQUE, G., WHITE, F. AND AZAM, I. (2004) Macrovascular complications and their associated factors among persons with type 2 diabetes in Karachi, Pakistan-a multi-center study. *J Pak Med Assoc.* **54**: 60-66.

8. MITTAL, A., SATHIAN, B., KUMAR, A., CHANDRASHEKHARAN, N. AND SUNKA, A. (2010) *Nepal Journal of Epidermiology.* **1 (1)**: 22-25.

9. MOLITCH, M.E., DEFRONZO, R.A., FRANZ, M.J., KEANE, W.F., MOGENSEN, C.E., PARVING, H.H. AND STEFFES, M.W. (2004) The American Diabetes Association: Nephropathy in diabetes (Position Statement). *Diabetes Care*. **27 (Suppl. 1):** S79 –S83.

10. NORRIS, K. AND NISSENSON, A.R. (2008) Race, gender, and socioeconomic disparities in CKD in the United States. *J Am Soc Nephrol.* **19(7)**: 1261–70.

11. PERRONE, R.D., MADIAS AND LEVEY, N.E. (1992) Serum creatinine as index of renal function. *Clin. Chem.* **38**: 1933-1953.

12. REMUZZI, G., SCHIEPPATI, A. AND RUGGENENTI, P. (2002) Nephropathy in patients with type 2 diabetes. *N Engl J Med.* **346:** 1145-51.

13. SCHUTTE, J.E., LONGHURST, J.C., GAFFNEY, F.A., BASTIAN, B.C. AND BLOMQVIST, C.G. (1981) Total plasma creatinine: an accurate measure of total striated muscle mass. *J Appl Physiol Respir Environ Exerc Physiol.* **51**:762-766.

14. SHERA, AS., JAWAD, F. AND MAQSOOD, A. (2004) Prevalence of chronic Complications and associated factors in type 2 diabetes. *J Pak Med Assoc.* **54**: 54-59.

15. SIVA, L, MYTHILI, S.V. AND KUMAR, P.S. (2012) Biochemical and Haematological Aberrations in Type I and Type II Diabetic Patients in South India-A Comparative Study. *International journal of research in pharmaceutical and biochemical sciences.* **3 (2***) : 2229-3701.

16. SIRWAL, I.A., BANDAY, K.A., RESHI, A.R., BHAT, M.A. AND WANI, M.M. (2004) Estimation of Glomerular Filteration Rate (GFR). *JK Science.* **6**: 121-123.

17. WAGLE, T.J. (2010) Gender wise comparison of serum creatinine and blood sugar levels in type-2 diabetic patients. *Bombay Hospital j.* **52***:64-40.

18. WHALEY CONNELL, A., SOWERS, J.R., MCCULLOUGH, P.A., ROBERTS, T., MCFARLANE, S.I. AND CHEN, S.C. (2009) Diabetes mellitus and CKD awareness: the Kidney Early Evaluation Program (KEEP) and National Health and Nutrition Examination Survey (NHANES). *Am J Kidney Dis.* **53(4)**: S11-21.