Original article

Glycemic Status and Renal Function among Type 2 Diabetics

Singh P[1], Khan S[2], Mittal RK[3]

Abstract:

Background: Diabetes mellitus (DM) is characterized by some specific complications including diabetic nephropathy. Urea & creatinine are useful parameters to diagnose the renal function, despite some limitations. ***Objective:*** This study aimed to analyze the effect of hyperglycemic condition on the renal function parameters like serum urea and serum creatinine. ***Methods:*** It was a cross sectional study. To determine the incidence of kidney dysfunction in type 2 diabetics in Nepalgunj Medical College and Hospital, Nepalgunj, Nepal. Random blood samples were taken from 100 diabetic subjects and 100 non-diabetic controls between the period 1st February, 2012 to 31st January, 2013 for investigation of fasting plasma glucose (FPG), blood urea and serum creatinine. These biochemical parameters were determined by using a fully automated clinical chemistry analyzer. The comparison was done by using Student 't' test. ***Results:*** Our findings showed that the level of blood urea ($P<0.0128$ Diabetic male and $P\approx0.0082$ Diabetic female) and serum creatinine ($P<0.0001$ Diabetic male and $P\approx0.0187$ Diabetic female) were significantly higher in type 2 diabetics as compared to non-diabetics in both male and female. There was no significant difference between diabetic male and female. High serum creatinine level was seen in males than females. ***Conclusion:*** In our study there was an increase of blood urea level in type 2 DM. Good control of blood glucose level is absolute requirement to prevent progressive renal impairment.

Key words: type 2 diabetes mellitus; urea; creatinine; renal function

Introduction:

Diabetic mellitus (DM) is a group of metabolic disorder characterized by chronic hyperglycemia due to derangement in carbohydrate, fat and protein metabolism that are associated with absolute or relative deficiencies in insulin secretion, insulin action or both[1].According to WHO, diabetes affects more than 170 million people worldwide[2], and affects more than 436,000 people in Nepal, and this number will rise to 1,328,000 by 2030[3]. The prevalence of diabetic patients has increased from 19.04% in 2002 to 25.9% in 2009 in Nepal[4].Diabetic patients are at an increased risk of developing specific complications including nephropathy, retinopathy neuropathy and atherosclerosis. Diabetic nephropathy occurs in approximately one third type 2 diabetes[5]. ? DM is the major cause of renal morbidity and mortality, and diabetic nephropathy is one of chronic kidney failure[6], accounting for nearly 44 percent of new cases[7]. Even when diabetes is controlled, the disease can lead to chronic kidney disease (CKD) and kidney failure. Kidney failure is the final stage of chronic kidney disease. Nearly 24 million people in the United States have diabetes and nearly 180000 people are living with kidney failure as a result of diabetes[8]. The prevalence of nephropathy in India was less (8.9% in Vellore, 5.5% in Chennai) when compared with the prevalence of 22.3% in Asian Indians in the UK[9]. In chronic renal failure patients the

1. Ms. Priti Singh, Lecturer, Department of Biochemistry, Nepalgunj Medical College, Nepal

2. Mr. Salman Khan, Assistant Professor, Department of Microbiology, Nepalgunj Medical College, Nepal

3. Dr Rabindra Kumar Mittal, Professor & Head, Department of Biochemistry, Nepalgunj Medical College, Nepal

Corresponds to: Ms. Priti Singh, Lecturer, Department of Biochemistry**,** Nepalgunj medical college, Chisapani**,** Banke , Nepal. **Email:** priti186631@gmail.com

prevalence of diabetic nephropathy was 30.3% followed by chronic interstitial nephritis (23%) and chronic glomerulonephritis (17.7%)[10]. In diabetic nephropathy, a number of serum markers are known to be deranged[11]. Urea & creatinine are the parameters to diagnose functioning of the kidney. Changes in serum creatinine concentration more reliably reflect changes in GFR than do changes in serum urea concentrations. Creatinine is formed spontaneously at a constant rate from creatinine, and blood concentrations depend almost solely upon GFR. Urea formation is influenced by a number of factors such as liver function, protein intake and rate of protein catabolism[12]. Information on plasma biochemical profiles of diabetic population in mid and far western region of Nepal is scarce. The aim of our study was to measure the glycemic status and renal function among type 2 diabetic patients of mid and far western region of Nepal.

Material and Method:

It was a cross sectional study, consisted of 200 subjects (age and sex-matched) divided into two groups: diabetic subjects (n=100) and non-diabetic controls (n=100). This study was carried out in the central

those are having history of diabetes up to five years Exclusion criteria- Patients with dehydration, muscle dystrophy, glomerulonephritis, pyelonephritis, hypertension, eclampsia preeclamsia urinary tract obstruction and congestive cardiac failure were excluded from the study.

Fasting venous blood sample was collected from all participants (both subjects and controls) into sample containers using a 5mL syringe. Each blood samples was mixed gently and spun as quickly as possible at 3000 rpm for 5 min. Plasma was extracted into plain tubes and frozen at   - 4^0 C until required for further analysis. . Estimation of serum glucose was done by glucose oxidase and peroxidase method[13]. The diabetic status was defined as per the American Diabetes Association (ADA)[14]. Similarly serum urea was estimated by Berthelot's method[15] while creatinine was estimated by alkaline Jaffe's Picrate method[16]. These biochemical parameters were determined by using a fully automated clinical chemistry analyzer. The normal level of creatinine was considered 0.8 to 1.4 mg/dL. Females usually have a lower creatinine (0.6 to 1.2 mg/dL) than males, because they usually have less muscle

Table 1: Sex distribution of subjects studied

Group	Male	Female	Mean age(years)
Non-diabetic subjects	50	50	48.13±11.72
Diabetic patients	50	50	47.76±11.78

laboratory of biochemistry of the Nepalgunj medical college and Hospital, Nepalgunj, Banke, Nepal between the period 1st February , 2012 to 31st January , 2013 . Blood samples from subjects and controls were taken for investigation of fasting plasma glucose (FPG), blood urea, serum creatinine .

Inclusion criteria- 1) Patients who fulfill selection criteria were included in this study. 2) Adult patients age between 30-65 years of either sex. 3) Patients

mass[17]. For urea normal range were consider 10-45 mg/dl[18].

Statistical analysis: The results were analyzed and expressed as mean ± SD by using Excel 2007. The comparison was done by Student t test using SPSS software, version (16), Inc, Chicago, IL, USA.

Ethical Issues: Ethical approval for the study was taken from the institutional research ethical committee.

Table 2: Blood glucose, creatinine and urea concentration in male non-diabetic controls and type 2 diabetic subjects.

Parameter	Non-diabetic controls(Male)	Diabetic patients subjects (Male)	P value*
Fasting (mg/dl)	90.63±6.17	161.77±20.57	<0.0001
Urea (mg/dl)	27.44±10.10	35.67±20.60	≈0.0128
Creatnine (mg/dl)	0.88±.26	1.14±0.25	<0.0001

* By Using Student t test

Results

The gender and age distribution of non-diabetic and diabetic subjects is showing in Table 1. Both Type 2 diabetic subjects and non-diabetic controls included

ly higher in type 2 DM subject males (Table-2) and females (Table-3).

Result obtained showed no significant difference in level of Blood glucose, urea and creatinine between

Table 3: Blood glucose, creatinine and urea concentration in female non-diabetic controls and type 2 diabetic subjects.

Parameter	Non-diabetic controls(Female)	Diabetic patients subjects (Female)	P value*
Fasting (mg/dl)	89.32±6.31	167.3±22.23	<0.0001
Urea (mg/dl)	27.46±10.44	36.28±20.60	≈ 0.0082
Creatnine (mg/dl)	0.86±.26	1.03±0.43	≈ 0.0187

* By Using Student t test

50 male and 50 females with mean age of 48.05 ± 11.72 and 47.76 ± 11.78 respectively.

Impairment renal function due to type 2 diabetes mellitus was assessed by measurement of plasma

2 DM subject males and females.**(Table-4 & figure-1)**
Discussion

The plasma creatinine and urea are established markers of GFR, though plasma creatinine is a more
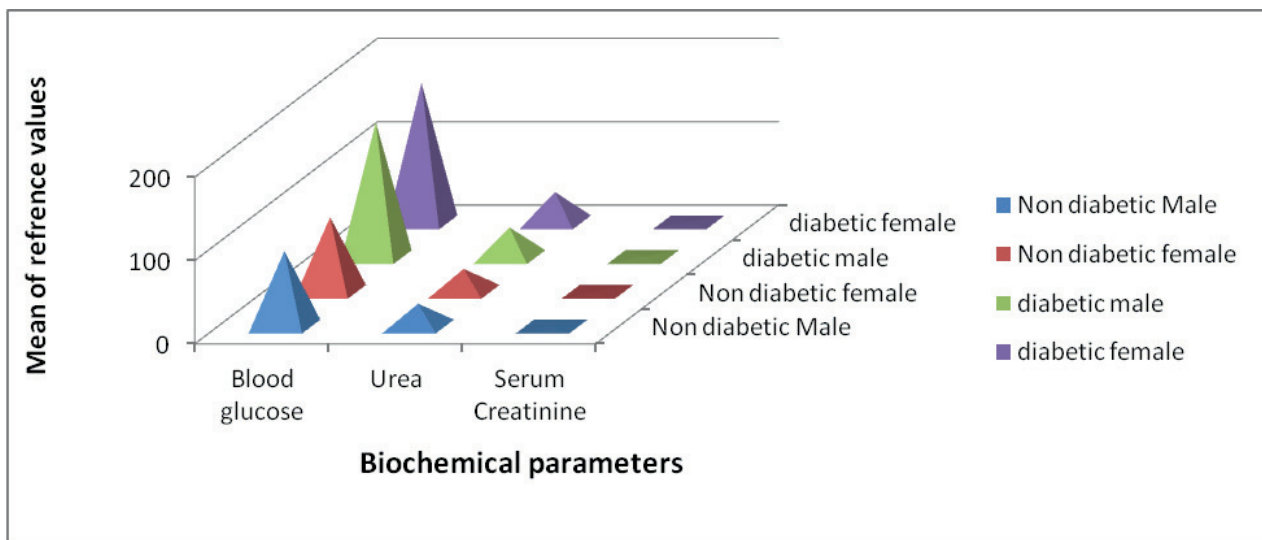
Table 4: Blood glucose, creatinine and urea concentration in male and female type 2 diabetic subjects. (NS-Non significant)

Parameters	Diabetic subjects		
	Male	Female	P value*
Blood glucose	161.77 ± 20.57	161.77±22.23	0.1997 NS
Urea	35.67±20.60	36.28±20.60	0.8826 NS
Serum creatinine	1.14±0.25	1.03±0.43	0.1211 NS

* By Using Student t test

concentrations of creatinine and urea in both type 2 diabetic subjects and non-diabetic controls. Fasting blood glucose concentration, plasma creatinine and urea concentrations were observed to be significant-

sensitive index of renal function. An increase in urea level is seen when there is damage to the kidney or the kidney is not functioning properly. Increment of blood urea level with the increment of blood sugar

Figure 1: Compare of Blood glucose, creatinine and urea concentration in male and female type 2 diabetic subjects.

level clearly indicates that the increase blood sugar level causes damage to the kidney. Research conducted by Anjaneyulu et al 2004 had found that increase urea and serum creatinine in diabetic rats indicates progressive renal damage[19].Joel Neugartan, et al studied effect of gender on progression of non-diabetic renal disease in 2000, and according to this study, men with chronic renal disease of various aetiologies show more rapid decline in renal function with time than do women[20].

Our observations we found blood glucose concentration, plasma creatinine and urea concentrations were observed to be significantly higher in type 2 DM subject males and females, were in accordance with the study (Bleesing O et al)[21] which showed raised plasma creatinine and urea levels in diabetic patients may indicate a pre-renal problem. This result is supported by various researchers who showed that sex wise variation occurs only in serum creatinine level but not in blood sugar level and urea level. High serum creatinine level was seen in males than females, which could be because of storage of creatinine as a waste product in muscle mass and the presence of high muscle mass in males[22].

Diabetic nephropathy, especially related to type 2 DM, has become the single most important cause of ESRD (end stage renal disease) worldwide. Management of traditional risk factors such as hyper tension, hyperlipidemia, and smoking to improve cardiovascular and renal outcomes continues to be important in patients with chronic kidney disease.

Conclusion:

In our study higher blood urea level was found in type 2 DM as compared to non-diabetics. To monitor the diabetes patients, estimation of blood urea level along with blood sugar level could be important. Good control of blood glucose level is absolute requirement to prevent progressive renal impairment. As our sample size was small and duration of study was limited, another study with larger sample size and longer duration is also recommended.

References:

1. Albreti, K.G.and P.G. Zimmet. Defnition, diagnosis and classification of diabetes mellitus and its complications:Part 1.Diagnosis and classification of diabetes mellitus, provisional report of a WHO consultation. *Diabetic Med.*1998;**15**:539-553 http://dx.doi.org/10.1002/(SICI)1096-9136(199807)15:7<539::AID-DIA668>3.0.CO;2-S

2. Wokama, F.S., 2002. Diabetes and hypertension in Africa: An Overview. *Diabetes Int*;**12**:36-40.

3. Wild SH, Roglic G, Sicree R, et al. Global Burden of Diabetes mellitus in the Year 2000 [online] 2004 [cited 2010 October 15]. Available from: http://www3.who.int/whosis/menu.cfm?path= evidence,burden,burden—gbd 2000 docs&language=english

4. Dulal RK, Karki S. Disease management programme for Diabetes mellitus in Nepal. *J Nepal Med Assoc* .2009;**48**:281-6

5. Rehman, G.,S.A. Khan and M.Hamayun. Studies on diabetic nephropathy and secondary diseases in type 2 diabetes. *Int. J. Diab. Dev.Ctries*.2005;**25**:25-29. http://dx.doi.org/10.4103/0973-3930.26755

6. Olimpia Ortega, Isabel Rodriguez, Alvaro Molina, Ana Hernandez. Chronic renal failure complications, cardiovascular morbidity/mortality. 2005;73-4.

7. United States Renal Data System. USRDS 2007 Annual Data Report. Bethesda, MD: National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health, U.S. Department of Health and Human Services, 2007

8. National Institute of Diabetes and Digestive and Kidney Diseases. National Diabetes Statistics, 2007. Bethesda, MD: National Institutes of Health, U.S. Department of Health and Human Services, 2008

9. Ramachandran A. Epidemiology of diabetes in India--three decades of research. *J Assoc Physicians India.*2005;**53**: 34-38

10. Ramachandran A. Socio-economic burden of diabetes in India. *J Assoc Physicians India.*2007;**55**:9-12

11. Taniguchi, A., M. Fukushima, Y. Seino, M. Sakai and S. Yoshii et al.Platelet count is independently associated with insulin resistance in non-obese Japanese type 2 diabetes patients. *Metabolism.*2003; **52**:1246-1249. http://dx.doi.org/10.1016/S0026-0495(03)00099-4

12. Griffin KA, Kramer H, Bidani AK: Adverse renal consequences of obesity. *American Journal of Physiology - Renal Physiology*. 2008;**294**:685-696. http://dx.doi.org/10.1152/ajprenal.00324.2007

13. Trinder P. Determination of glucose in blood using glucose oxidase with an alternative oxygen acceptor. *Ann Clin Biochem* .1969;**6**:24-7. http://dx.doi.org/10.1177/000456326900600108

14. The Expert Committee on the Diagnosis and Classification of Diabetes Mellitus: follow-up report on the diagnosis ofdiabetes mellitus. *Diabetes Care* 2003;**26**:3160–67. http://dx.doi.org/10.2337/diacare.26.11.3160

15. Berthelot M.: Report Chem.*Aplique* .1859;**6**:1:284.

16. Owen A, Iggo B, Scandrett FJ, Stewart, CP. The determination of creatinine in plasma or serum and in urine: A critica1examination. *Biochem J.* 1954;**58**:426.

17. Molitoris BA. Acute kidney injury. In Goldman L, Ausiello D, editors. Cecil Medicine. 23rd ed. Philadelphia, Pa: Saunders Elsevier, 2007: chap 121

18. Gurjeet Singh, Vikas Gupta, Anu Kumar Sharma and Neeraj Gupta, Evaluation of Thyroid Dysfunction Among type 2 diabetic Punjabi Population, *Advances in bioresearch*.2011;**2**(1): 03-09

19. Anjaneyulu, Muragundla; Chopra, Kanwaljit quercetin, an anti-oxidant biofl avonoid, attenuates diabetic nephropathy in rats. *Clinical & Experimental Pharmacology & Physiology*.2004;**31**:244-8, http://dx.doi.org/10.1111/j.1440-1681.2004.03982.x

20. Joel Neugarten, Anjali Acharya, Sharon, Silbiger, Effect of gender on progression of Non-Diabetic Renal Disease, *J Am SocNephrol*.2000:319-29.

21. Blessing O. Idonije, Oloruntoba Festus and Olarewaju M. Oluba, Plasma glucose, creatinine and urea levels in type 2 diabetic patients attending a Nigerian teaching hospital, *Research journal of medical sciences* .2011;**5**(1):1-3

22. Ashavaid TF, Todur SP, Dherai AJ. Establishment 9. of reference intervals in Indians population. *Ind J of Clin Biochem.* 2005;**20**:110-8. http://dx.doi.org/10.1007/BF02867409