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## RESEARCH ARTICLE

**RENAL FUNCTION IMPAIRMENT IN INSULIN DEPENDENT AND NON INSULIN DEPENDENT DIABETIC PATIENTS**Rasool Mohammad<sup>1</sup>, Mukhtiar Hassan<sup>1</sup>, Abdul Wahab<sup>2\*</sup><sup>1</sup>Department of Biochemistry, Hazara University Dhodial, Mansehra, Khyber Pakhtunkhwa, Pakistan<sup>2</sup>Department of Pharmacy, Kohat University of Science and Technology, Khyber Pakhtunkhwa, Pakistan

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**ABSTRACT**

The research study was undertaken to investigate the effect of renal function impairment in insulin dependent and non insulin dependent diabetic patient in biochemistry department Hazara University Mansehra, Khyber pakhtunkhwa, Pakistan. For the study a District Head Quarter Hospital Bannu is selected. A total samples were taken from 100 individuals i.e. 33 insulin dependent, 33 non insulin dependent diabetic patients and 34 were control group. The blood samples from the individuals were collected for estimation of glucose in sodium flurried tube while urine, creatine and uric acid lithium heparin coated tube. Relevant data was recorded throughout the experiment till the termination of experiment; data was subjected to statistical analysis using ANOVA design. Level of significance ( $P < 0.05$ ) were taken in every group. In this experiment weight was found significant in both groups as compared to control, while other the population, habits, nutrition and body mass index (gender, age, ethnic groups, location, marital status, occupation income/month, smoking, alcohol, drugs, dietary habits, dietary assessment, obesity, height) were no significant ( $P < 0.05$ ) value observed in different groups of diabetic patients in all above parameters. In case of disease effects, body effects, serum, urinary profile the parameters (duration, family history of disease, treatment, blood sugar, blood urea, blood creatinine, urinary protein, urinary sugar) were found high significant ( $P < 0.05$ ) value in both groups of diabetic patients, while the other parameters (diabetes, diabetes types, allergy, blood pressure (Upper) blood pressure (Lower), radial pulse, hypertension, heart disease, doctor visit, and uric acid) were no significant ( $P > 0.05$ ) value between the different groups. It is concluded that renal function were affected in both groups of diabetic patients on the basis of receiving data from the above different parameters.

**Key words:** insulin dependent, non-insulin dependent, diabetic patients, Control**INTRODUCTION**

Diabetes Mellitus is a chronic metabolic disorder that can guide to serious cardiovascular, renal, neurological and retinal complications<sup>1</sup>.

The main complications of diabetes include abnormalities of the vessel wall structure and function, which results in both micro and macro vascular disease. Vascular disease is two to eight times more common in diabetic than non diabetic individuals, and remains the most important cause of death in diabetic patients<sup>2</sup>. The function of hyperglycemia has recently been studied as the most important factor in the beginning and progression of diabetic complications<sup>3</sup>. Although a number of factors are involved in the beginning of diabetic nephropathy, glomerular hyper filtration with increased intra glomerular pressure before dates the improvement of nephropathy and appears to put in to the diabetes linked renal injury<sup>4</sup>. In 1988 approximately one third of these individuals will build up diabetic nephropathy<sup>5</sup>. About 30 to 40% of Diabetes Mellitus patients develop clear diabetic nephropathy which additionally impairs lipid metabolism<sup>6</sup>.

In type 2 diabetes the course of diabetic nephropathy is less well differentiates, due to the often unknown date of beginning of disease or other causes influencing progression of nephropathy such as hypertension, age and other components of metabolic syndrome. Patients with diabetic nephropathy with type 2 diabetes have a high cardiovascular danger<sup>7</sup>. Thus in type 2 diabetes; numerous patients may not reach End Stage Renal Disease (ESRD) due to early death from cardiovascular event<sup>8</sup>.

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The earliest clinical indication of nephropathy is the look of low but abnormal levels (>30 mg/day or 20ug/min) of albumin in the urine, i.e. microalbuminuria about 80% of type 1 diabetes who develop continued microalbuminuria have their urinary albumin excretion speed increase from 10-20% per year. Once nephropathy happens, the glomerular filtration rate (GFR) slowly falls over a period of several years at a rate that is highly changeable from individual to individual (2-20 ml/min/year)<sup>9</sup>.

Recent studies pointed out that the majority diabetic complications like nephropathy are vascular initiated<sup>10</sup>. Diabetic nephropathy is the main reason of morbidity and mortality in diabetic patients and in adults constant "microalbuminuria" urinary albumin excretion rate is the best indicator for the resulting risk of its development<sup>11</sup>.

The laboratory marker that has long served as the foundation for detecting impaired renal function is serum creatinine. The second factor is that the opposite relationship between GFR and serum creatinine expects that the large reductions in GFR from normal produce absolute increases in serum creatinine<sup>12</sup>. Glomerular filtration rate (GFR) expects double chances progression to diabetic kidney disease<sup>13</sup>.

**MATERIALS AND METHODS**

**Patients' selection**

Previously registered diabetic patients with type 1 and type 2 diabetes mellitus of both sexes admitted in diabetic wards and visiting outdoor patients of DHQ Hospital Bannu, women and children Hospital Bannu, were selected for the study after informed consent was obtained. The age of patients was more than 20 years. Their diabetes age was more than one year. The study procedure was approved by the regulations of Medical superintendent (MS) of DHQ Hospital Bannu, for the use of human subjects in research.

**Exclusive criteria**

The following patients were excluded from the study:

- Individuals with urinary tract infection
- Pregnant diabetic women
- Patients having any mental disorder
- Individuals having any past medical history of various vascular complications before the diagnosis of diabetes mellitus such as heart failure or renal failure.
- Those who did not consent to participate in the study.

**Study design**

Total one hundred (100) individuals were selected as sample of the study. Out of these 33 individuals were insulin dependent diabetic patients, 33 non insulin dependant diabetic patients while 34 individuals were taken as a control group.

**Sampling technique**

Convenient/non probability sampling.

**Development of questionnaire**

Questionnaire was used as a tool for collection of data. The questionnaire consists of 36 items. Same questionnaires were used for all the three groups. Questionnaire were used to note all about blood parameters like blood sugar, blood urea, blood creatinine, blood uric acid, urinary protein, and urinary sugar including demographic features of all the diabetic patients and control group.

**Sample collection**

The fasting blood samples were collected from each patient and control after 12-hour of fasting. It was ensured that the patient has not taken any anti diabetic, anti hypertensive drug known to influence the glycemic status and renal function. The blood samples for estimation of glucose were collected in sodium fluoride tube while urea, creatinine and uric acid in lithium-heparin coated tubes.

**Sample preparation**

Serum was separated from the clotted blood through centrifuge to analyze blood parameters. Blood samples were processed the same day for estimations of sugar, urea, creatinine, uric acid.

**Analysis**

**(A) Quantitative analysis**

**(i) Estimation of blood glucose by enzymatic calorimetric method.**

**Procedure**

2 ml Glucose solution was taken in a tube. Then added 0.2ml of clear serum. In another tube 2 ml glucose reagent and 0.2 ml standard was taken. Then mixed it, placed in water bath at 37<sup>0</sup> C for 10 minutes. Then absorbance was taken through colorimeter. But before the examination, the machine was adjusted at 0 levels with distilled water. Concentration of glucose in serum was calculated in terms of mg/dl.

Results were calculated by using the following formula

$$C = 100 \times \frac{T \text{ (Sample)}}{S \text{ (Standard)}} \text{ (mg / dl)}$$

**(ii) Estimation of blood urea by enzymatic calorimetric method.**

**Procedure**

2 ml Urea solution was taken in a tube. Then added 0.2ml of clear serum. In another tube 2 ml urea reagent and 0.2 ml standard was taken. Then mixed it, placed in water bath for 37<sup>0</sup> C and waited for 10 minutes. Then absorbance was taken through colorimeter. But before examination machine was adjusted at 0 levels with distilled water.

Results were calculated by using the following formula:

$$C = 50 \times \frac{T \text{ (Sample)}}{S \text{ (Standard)}} \text{ (mg / dl)}$$

**(iii) Estimation of uric acid by enzymatic calorimetric method.**

**Procedure**

2 ml Uric Acid solution was taken in a tube. Then added 0.2ml of clear serum. In another tube 2 ml uric acid reagent and 0.2 ml standard was taken. Then mixed it and waited for 10 minutes, placed in water bath for 37<sup>0</sup> C. Then absorbance was taken through colorimeter.

Results were calculated by using the following formula

$$C = 8 \times \frac{T \text{ (Sample)}}{S \text{ (Standard)}} \text{ (mg / dl)}$$

**(iv) Estimation of blood creatinine by enzymatic calorimetric method .**

**Procedure**

2 ml Creatinine solution was taken in a tube .Then added 0.2ml of clear serum. In another tube 2 ml

creatinine reagent and 0.2 ml standard was taken. Then mixed it and waited for 10 minutes, placed in water bath for 37<sup>0</sup> C. Then absorbance was taken through colorimeter.

Results were calculated by using the following formula:

$$C = 2 \times \frac{T \text{ (Sample)}}{S \text{ (Standard)}} \text{ (mg / dl)}$$

**(B) Qualitative analysis**

**( i ) Determination of urinary glucose by benedicts method**

**Procedure**

5ml Benedict solution in clean test tube was taken. Then heated the solution till boiling for two minutes. Then putted 8 drops of fresh urine and boiling up to 2 minutes.

**Report**

The glucose concentration was as follows:

**Appearance of the solution**

COLOUR	GRADATION	PERCENTAGE.
- Blue	(--) Nil	0 %
Green Non precipitation	(+)	trace less than
= = = = =	(+)	0.25 mg/dl
Yellow & cloudy	(+ +)	0.5 %
Orange & cloudy	(+ + +)	1 %
Dark & cloudy	(+ + + +)	1.5

**(ii) Determination of urinary protine by heat method.**

3/4 ml urine was taken in a tube. Heated it while rotating the tube urine if become clouded protein or Phosphates were presents. Then added 2-3 drops of acetic acid, if turbidity persists, then protein was present in urine.

**Report**

The urinary protein concentration was obtained as follows.

GRADATION	PERCENTAGE
Trace	20mg
+	30mg
++	50mg
+++	75mg

**RESULTS**

Table 1 describes that no significant (p>0.05) value was observed in both type ID/NID diabetic patients, as compared to control group. The parameters like gender, age, ethnic groups, location, marital status and occupation in diabetic patients were no significant (p>0.05) value observed. While in case of income/month of the population significant (p>0.05) value were observed.

Table 2 shows no significant (p>0.05) value in both type ID/NID diabetic patients as compared to control group. All parameters like smoking, alcohol, drugs, dietary habits, and dietary assessment In Table 2 were no significant (p>0.05) value

Table 3 shows no significant (p<0.05) value in parameters like obesity, height in both (ID/NID) types of diabetic patients as compared to control. While in case of weight significant (p<0.05) value was observed in both types diabetic patients. Which prove that weight effect renal function impairment in insulin dependent and non-insulin dependent diabetic patients.

Table 4 indicates high significant (p<0.05) value in

various parameters in both types (ID/NID) of diabetic patients like duration of diabetes, family history and treatment as compared to control groups. While for parameter of allergy no significant ( $p > 0.05$ ) value was obtained.

The parameters in both types of diabetic patients were given in Table 5. The results show no significant ( $p < 0.05$ ) value in parameters like BP upper, BP lower, radial pulse, hypertension, heart disease and doctor visit in both types of diabetic patients as comparison to control group.

Table 6 shows significant ( $p < 0.05$ ) value in various blood parameters in both types' diabetic patients. The blood parameters like blood creatinine and uric acid no significant ( $p < 0.05$ ) value were observed as compared to control group. While parameter like blood sugar, blood urea, urinary sugar, urinary protein were high significant ( $p < 0.05$ ) value in diabetic patients. which indicate the risk of renal function impairment in insulin and non insulin dependent diabetic patients is greater as the compare to control group.

**Table 1 Comparison of insulin dependent and non insulin dependent (ID/NID) groups of diabetic patients in various parameters with Control in the Study of population, (Gender, Age, Ethnic group, Location, Marital status, Occupation, Income/month).**

S/No	Parameter	Groups – Interaction	Sum	Sum of Sq	Df	Mean	Std. D	F	P –value
1	Gender	BG/WG	130	21.000	99	1.30	.461	.384	.682
2	Age	BG/WG	149.00	38.990	99	1.4900	.62757	2.585	.081
3	Ethnic Groups	BG/WG	212.00	150.560	99	2.1200	1.23321	.537	.586
4	Location	BG/WG	255	98.750	99	2.55	.999	.557	.575
5	Marital Status	BG/WG	114	12.040	99	1.14	.349	3.527	.033
6	Occupation	BG/WG Total	319	245.390	99	3.19	1.574	1.522	.224
7	Income	BG/WG	344.00	226.640	99	3.4400	1.51304	5.608	.005

- n=100
- $p < 0.05$  as compared to control group.
- BG: Between Groups.
- WG: Within Groups

**Table 2 Comparison of insulin dependent and non insulin dependent (ID/NID) groups of diabetic patients in various parameters with control in the Study of habits and nutrition's (Smoking, Alcohol, Drugs, Dietary Habits, Dietary Assessment).**

S/No	Variable	Groups - Interaction	Sum	Sum of Squares	df	Mean	Std. Deviation	F	P-value
1	Smoking	BG/WG Total	155.00	24.750	99	1.5500	.50000	1.101	.337
2	Alcohols	BG/WG Total	200.00	.000	99	2.0000	.00000	1.706	.108
3	Drugs	BG/WG Total	179.00	16.590	99	1.7900	.40936	2.378	.098
4	Dietary Habits	BG/WG Total	159.00	24.190	99	1.5900	.49431	.201	.818
5	Dietary Assessment	BG/WG Total	144.00	24.640	99	1.4400	.49889	2.467	.090

- n=100
- $p < 0.05$  as compared to control subjects.
- BG: Between Groups.
- WG: Within Groups.

**Table 3: Comparison of insulin dependent and non insulin dependent (ID/NID) groups of diabetic patients in various parameters with Control in the Study of BMI (Obesity, Height, Weight)**

S/No	Parameter	Groups - Interaction	Sum	Sum of Squares	Df	Mean	Std. Deviation	F	p-value
1	Obesity	BG/WG	164.00	23.040	99	1.6400	.48242	1.884	.157
2	Height	BG/WG	165.00	22.750	99	1.6500	.47937	.456	.635
3	Weight	BG/WG	284.00	43.440	99	2.8400	.66241	8.663	.000

- n=100
- p<0.05 as compared to control subjects.
- BG: Between Groups.
- WG: Within Groups.

**Table 4: Comparison of insulin dependent and non insulin dependent (ID/NID) groups of diabetic patients in various parameters with control in the Study of disease effects, (Diabetes, Duration, Diabetes Type, Family History, Treatment and Allergy).**

S/No	Parameter	Groups Interaction	Sum	Sum of Squares	df	Mean	Std. Deviation	F	P-value
1	Diabetes	BG/WG Total	134.00	22.440	99	1.3400	.47610	20.342	.054
2	Duration	BG/WG Total	222.00	125.160	99	2.2200	1.12439	79.254	.000
4	Diabetes Type	BG/WG Total	201	66.990	99	2.01	.823	23.762	.065
5	Family History	BG/WG Total	145.00	24.750	99	1.4500	.50000	19.908	.000
6	Treatment	BG/WG Total	141.00	24.190	99	1.4100	.49431	143.164	.000
7	Allergy	BG/WG Total	178.00	17.160	99	1.7800	.41633	.034	.967

- n=100
- p<0.05 as compared to control subjects.
- BG: Between Groups.
- WG: Within Groups.

**Table 5: Comparison of (ID/NID) groups of diabetic patients in various parameters with control in the Study of body effects (BP Upper, BP Lower, Radial Pulse, Hypertension, Heart Disease & Doctor Visit) body effects.**

S/No	Parameter	Groups – Interaction	Sum	Sum of Squares	Df	Mean	Std. Deviation	F	p-value
1	BP Upper	BG/WG Total	217.00	64.110	99	2.1700	.80472	1.128	.328
2	BP Lower	BG/WG Total	136.00	41.040	99	1.3600	.64385	3.033	.053
3	Radial Pulse	BG/WG Total	183.00	14.110	99	1.8300	.37753	5.952	.004
4	Hypertension	BG/WG Total	154.00	24.840	99	1.5400	.50091	1.384	.255
5	Heart Disease	BG/WG Total	175.00	18.750	99	1.7500	.43519	.772	.465
6	Doctor Visit	BG/WG Total	147.00	24.910	99	1.4700	.50161	5.263	.007

- n=100
- p<0.05 as compared to control subjects.
- BG: Between Groups.
- WG: Within Groups.

**Table 6: Comparison of (ID/NID) groups of diabetic patients in various parameters with control in the Study of serum/urinary profile, (Blood Sugar, Blood Urea, Blood Creatinine, Urinary Sugar, Urinary Protein, and Uric Acid).**

S/No	Parameter	Groups – Interaction	Sum	Sum of Squares	df	Mean	Std. Deviation	F	p-value
1	Blood Sugar	BG/WG Total	209.00	168.190	99	2.0900	1.30341	104.917	.000
2	Urinary Protein	BG/WG Total	179.00	16.590	99	1.7900	.40936	8.236	.000
3	Urinary Sugar	BG/WG Total	176.00	18.240	99	1.7600	.42923	11.568	.000
4	Blood Urea	BG/WG Total	165.00	56.750	99	1.6500	.75712	12.415	.000
5	Blood Creatinine	BG/WG Total	138.00	43.560	99	1.3800	.66332	6.376	.003
6	Blood Uric Acid	BG/WG Total	305.00	80.750	99	3.0500	.90314	1.123	.330

- n=100
- p<0.05 as compared to control subjects.
- BG: Between Groups.
- WG: Within Groups

**DISCUSSION**

Diabetes mellitus has become the mainly common single cause of renal function impairment in various parts of the world in general, and in rising countries in particular. Diabetes mellitus and hypertension are interconnected diseases<sup>14</sup>. Diabetes causes unique changes in kidney structure<sup>15</sup>. In present study, we evaluated the variation in normal renal functions. The development of diabetic complications is varies amongst different ethnic groups<sup>16</sup>. The development of chronic complications of diabetes are known to be interconnected to certain factors such as increased age, gender and occupation<sup>17</sup>. In the present study there were no significant (P>0.05) value observed in different parameters like ethnic groups, age, gender and occupation shown in Table 1. The result shows a contrast relation to the previous study of (USRDS, 2003, Nicolucci *et al*, 1998)<sup>16,17</sup> about diabetes patients. However there were no previous relevant studies conducted about the parameters like location, income/month and marital status.

The Studies of the development of complications in diabetes is in longer period of smoking, history of drugs and alcohol<sup>18</sup>, less dietary assessment in diabetes has shown diabetic nephropathy<sup>19</sup>, also to be the leading cause to End Stage Renal Disease (ESRD) has been seen effected by smoking, history of drugs and alcohol<sup>20</sup>. It is documented in a variety of previous studies that the above parameters significantly affect on diabetes patients. In our study no significant (p>0.05) value was observed (Table 2). The results of present study given in Table (2) were not in the line with the previous studies of (MRFITR, 1993, Wannamettee *et al*, 2000, Shera *et al*, 2004)<sup>18-20</sup>.

Increased body weight is widely accepted as the clinical sign of diabetic nephropathy patients<sup>21</sup>. Overall obesity and high abdominal fats “central obesity” are particularly more prevalent in individuals with Type 2

diabetes. Central obesity and diabetes association is particularly greater in women and the taller individuals are more probable to develop diabetic nephropathy than shorter ones<sup>22</sup>, (Dawn, 2001). It is observed in our study that in case of parameters like obesity and height no significant (p>0.05) value is observed in table (3) which shows contrast case like the previous study of <sup>22</sup>(Dawn, 2001)<sup>22</sup>. while increased body weight, significant (p<0.05) value found as compared to low weight diabetic patient (Table 3). These results of our study indicate similarity to previous study reported of (Caramori *et al*, 2003)<sup>21</sup>.

A family history, no enough treatment and longer duration of diabetes have a major risk factors for diabetes in worldwide. In Pakistan about 44 percent of people with Type 2 diabetes patients have a positive family history of diabetes<sup>23</sup>. The present study show high significant (p<0.05) value which is visible in the case of parameters like family history, longer duration of diabetes and no enough treatment. In our study, high significant effect in the above parameters of diabetes were shows same case like the previous study of (Hashim *et al*, 1999)<sup>23</sup>. While no previous relevant study was found about the parameter of allergy in (Table 4).

Although microalbuminuria is usually the first symptom of diabetic renal disease<sup>24</sup>. In patient blood pressure and hypertension may proceed before time its development. Hypertension is also a major risk factor for cardiovascular events, such as stroke as well as micro vascular complications such as retinopathy and nephropathy<sup>25</sup>. But our study (Table 5) not shows significant effects of blood pressure and hypertension on renal function impairment in diabetic patients. Our findings were contrast to the result reported by other authors of (Lurbe *et al*, 2002, Carlos *et al*, 2002)<sup>24,25</sup>. It is also clear in our study that no strong and significant correlation were observed of diabetic patients and

control with blood pressure and hypertension and also no significant correlations were observed between blood pressure and hypertension in diabetic patient about renal disease. These observations indicate the disturbances of individual body due to diabetes resulting only in increase hypertension as well as blood pressure.

Increased urea is widely accepted as the first clinical sign of renal function impairment. This indicates that serum urea is the first factor to indicate the weakening in kidneys of diabetic patients. It is also reported that the laboratory marker has long causes for the basis of detecting impaired kidney function is the serum creatinine<sup>12</sup>. A strong correlation was also observed between serum urea and creatinine in diabetic patients. It is therefore confirmed that higher the concentration of urea, more rapid will be the decline in the creatinine and the higher risk of weakening of renal function<sup>26</sup>. The present study in (Table 6) the parameter of serum urea levels were found significant ( $p < 0.05$ ) value in diabetes patients. It indicates that serum urea alone was a significant marker to evaluate the renal damage in diabetic kidney patients. In the present study blood creatinine also shows high significant ( $p < 0.05$ ) value. These show parallel end result to previous study of (Star *et al*, 2002, Adroque *et al*, 1986)<sup>12,26</sup>.

In patients with nephropathy the ratio of urinary protein and creatinine in a single specimen are interconnected. The patients with urinary protein and creatinine ratio more than normal had a progressive decrease in the kidney function. These also exceed 30 percent per year in urinary protein excretion patient more than four times than normal<sup>27</sup>. Present study (Table 6) shows high significant ( $p < 0.05$ ) value observed in case of parameters like protein and creatine. These prove a same case to the previous study of (Rodby *et al*, 1995)<sup>27</sup>.

On the other hand, Microalbuminuria is a recognized risk factor for the development of diabetic nephropathy. Microalbuminuria may be observed as an early indicator of diabetic kidney disease, as renal structural abrasion can be detected at this stage. Patients with reduced renal functional reserve capacity may be more lying face down to microalbuminuria when exposed to conditions such as hyperglycemia. Hyperglycemia is related an independent risk for the loss of sugar in urine from diabetic patients<sup>28</sup>. The present study (Table 6) shows significant ( $p < 0.05$ ) value in parameters of blood sugar and urinary sugar in diabetic patients as compared to control (figure 4.6). Which is valid resemblance to the previous study of (Lee, 2005)<sup>28</sup>. The result from present

study in both types of diabetes patients indicate that an increased blood sugar level even within the normal range most likely reflects abnormal kidney function and increased urinary sugar may influence to diabetic nephropathy<sup>28</sup>.

The data of present study about diabetes mellitus type 1 (ID) and diabetes mellitus type 2 (NID) shows that an increased urea level even within the normal range in blood most likely to reproduce abnormal creatinine, which may proceed to diabetic renal function impairment in both types, insulin dependant and non insulin dependent diabetic patients.

## CONCLUSION

In the last few years, we have faced vast care in the understanding of the risk factors and mechanisms of diabetic nephropathy, the stages of renal participation in diabetes, and the treatment plan to prevent or interrupt the development of diabetic nephropathy.

From the findings of our present study, it is definitely indicated that the renal function are significantly changed during the development of diabetes mellitus disease. This also affects the abnormality in intra and extra cellular distributions of other complications. Increase blood urea and creatinine once developed precede the renal function impairment in insulin dependant and non insulin dependant diabetes patients. Hypertension in diabetes may precede the patients towards kidney weakening with all of its symptoms. Moreover the blood pressure control has been a challenge for health care professionals in checking their patients towards diabetic vascular complications. It is recommended that hard line antihypertensive treatment, and the use of Angiotensin Converting Enzyme (ACE) inhibitors or Angiotensin Receptor Blockers (ARB) treatment plan will slow the progression of diabetic nephropathy. Hyperglycemia is an independent risk factor for diabetic vascular complications. It is associated with loss of renal functions. Rigid glycemic control is a major objective in preventing the complications of diabetes for example the renal function and nephropathy.

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