

A Study to Evaluate the Blood Urea & Serum Creatinine with HbA1c in Diabetes Mellitus Patients: A Retrospective Study

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Abstract

Aim: The aim of the present study was to evaluate the blood urea & serum creatinine with HbA1C in Diabetes mellitus patients.

Methods: The present study was conducted in the Department of Biochemistry in ESICMCH, Bihta, Patna, Bihar, India from November 2021 to October 2022. Our study comprises of 100 subjects with age limit between 35-65 years. Our study group compared with normal healthy age matched controls. These are healthy and not having the history of diabetes. Patients with normal blood glucose and normal renal functions tests are taken as controls.

Results: Out of 100 cases, we had 25 samples with increased Urea, 35 samples with more creatinine and 40 samples increased with both urea and creatinine when compared with controls. In our study group, males having more creatinine value compared to females due to presence of more muscle mass. Increased blood urea and serum creatinine values are observed in diabetic patients when compared with controls. There was no increase in blood urea and serum creatinine in controls. Mean fasting, and post prandial blood sugar was found to be higher in diabetics subjects when compared to non-diabetic. HbA1C also found to be higher in diabetics. Blood sugar and serum creatinine increases in cases compared with the controls. Both blood urea and serum creatinine shows statistically significant value ($p < 0.001$).

Conclusion: Our study showed that blood urea and serum creatinine can be used as biomarkers in the early detection of diabetic nephropathy. These parameters help in reducing the severity of renal failure.

Keywords: Glycosylated hemoglobin, Diabetes mellitus, Renal nephropathy

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Introduction

Diabetes mellitus is a heterogeneous disturbance of metabolism which the main finding is chronic hyperglycemia. The cause is either impaired insulin secretion or impaired insulin action or both. [1] According to World Health Organization (WHO) 2006 diagnostic criteria for Diabetes mellitus (DM) are fasting plasma glucose ≥ 126 mg/dl (7.0mmol/l), 2-h plasma glucose ≥ 11.1 mmol/l (200mg/dl) or HbA1C $\geq 6.5\%$. [2] Patients with diabetes mellitus have either Type-1 diabetes (T1DM) or Type-2 DM (T2DM). Type-2 DM is the most common form of diabetes mellitus accounting for 90-95% of the cases. [3] T2DM is characterized by hyperglycemia, insulin resistance and relative insulin deficiency. [4] The chronic hyperglycemia of diabetes causes to significant long-term effects on various organs like heart, kidneys, eyes, nerves and blood vessels. [5] T2DM is caused by a combination of genetic factors related to impaired insulin secretion, insulin resistance and environmental factors such as obesity, overeating, physical inactivity, stress and as well as aging. [6] Urea is the major nitrogenous end

product of metabolic breakdown of protein in humans. It is dissolved in the blood and transported and excreted by the kidney as a component of urine. [7]

Creatinine is the breakdown product of creatine phosphate released from skeletal muscle at a steady state. It is filtered by the glomerulus and a small amount is also secreted into the glomerular filtrate by the proximal tubules. Serum creatinine and blood urea nitrogen concentrations are the best guidelines for estimating progression, prognosis, instituting dietary restrictions in the renal disease in type 2 DM. [8] Impairment of urea and creatinine level due to increased blood glucose level indicates reduction in kidney function in diabetic patients. [9] Diabetic kidney disease (DKD) develops in about 40% of patients who are diabetic and is the leading cause of chronic kidney disease (CKD) worldwide. Metabolic changes caused by diabetes leads to glomerular hypertrophy, glomerulosclerosis, tubulointerstitial inflammation and fibrosis. Due to

this there is large residual risk of DKD onset and progression. [10]

About a third of patients with type 2 DM may suffer from diabetic nephropathy. [11] Several signs of serum in diabetic nephropathy are known to be abnormal with significance in morbidity [12] which is followed by scarring of tissue, loss of protein by urine and finally CKD, therefore kidney dialysis and transplants are at times necessary. [13] Unhealthy lifestyles have contributed to rising type 2 diabetes, involving obesity (where body mass index is more than 30), decreased exercise, bad nutritional habits, stress, and urbanisation. [14] In the case of diabetic nephropathy, vital signs such as urea and creatinine in serum are known to increase with high blood sugar in patients with uncontrolled diabetes and is usually associated with damage in the kidney. Urea and creatinine levels in the blood can help detect and prevent diabetic renal disease earlier and can restrict the development of end-stage kidney failure (ESKF). [15,16]

The aim of the present study was to evaluate the blood urea & serum creatinine with HbA1C in Diabetes mellitus patients.

Materials and Methods

The present study was conducted in the Department of Biochemistry in ESICMCH, Bihta, Patna, Bihar, India from November 2021 to October 2022. Our study comprises of 100 subjects with age limit between 35-65 years. Our study group compared with normal healthy age matched controls. These are healthy and not having the history of diabetes. Patients with normal blood glucose and normal renal functions tests are taken as controls.

Inclusion Criteria

Patients with past history of diabetes mellitus for last 3 years were taken as cases.

Exclusion Criteria

Smokers, hypertensives, hyperlipidemic, pregnant women and other chronic disorders are excluded from our study.

Written consent was obtained followed by detailed medical personal history and systemic examination. Variables collected were age, gender, fasting & post prandial blood glucose, HbA1C, blood urea and serum creatinine of all subjects.

Blood samples of both cases and controls were collected to study the biochemical parameters like blood urea, serum creatinine, FBS, PPBS, HbA1C. Biochemical parameters were analyzed in clinical biochemistry laboratory using commercial kit adapted to auto analyzer. Serum was separated by centrifugation at 4,000 rpm for 10 mi. Plasma glucose level was estimated by glucose oxidase and peroxidase (GOD-POD) end point assay method. 15 Blood urea by enzymatic urease method 16 while serum creatinine by alkaline Jaffe’s method. 17 HbA1C of all subjects in the study was estimated by ion exchange resin method using diagnostic HbA1C kit. Mean SD was calculated.

Normal range of fasting plasma glucose is 70-110 mg/dl, post prandial less 140mg/dl. Normal range of urea: 15- 40mg/dl and creatinine: 0.6-1.4 mg/dl, 0.5- 1.2mg/dl for both males and females respectively & HbA1C 6. WHO criteria were followed to categorize the people with Diabetes Mellitus.

Statistical Analysis

Data collected using excels statistical data was analyzed by student t-test to compare the significance between diabetic and non- diabetic control groups. P value less than 0.05 was considered as statistically significant.

Results

Table 1: Indicates number of samples showing increased amount of Blood urea and serum creatinine in both diabetics and non- diabetics

Parameters	Cases (n=100)	Controls(n=100)
Blood Urea increased	25	0
Serum Creatinineincreased	35	0
Both Urea and Creatinineincreased	40	0

Out of 100 cases, we had 25 samples with increased Urea, 35 samples with more creatinine and 40 samples increased with both urea and creatinine when compared with controls. In our study group, males having more creatinine value compared to

females due to presence of more muscle mass. Increased blood urea and serum creatinine values are observed in diabetic patients when compared with controls. There was no increase in blood urea and serum creatinine in controls.

Table 2: Indicates mean \pm SD of blood urea and serum creatinine and correlated with FBS, PPBS & HbA1C in both cases and controls

Parameters	Cases	Controls	P Value
FBS	186.34 \pm 32.48	96.74 \pm 9.18	0.001
PPBS	272.18 \pm 44.16	124.26 \pm 6.54	0.001
HbA1c	6.55 \pm 0.05	5.18 \pm 0.43	0.001
Blood Urea	64.86 \pm 12.18	26.64 \pm 5.35	0.001
Serum creatinine	1.86 \pm 0.84	0.82 \pm 0.14	0.001

Mean fasting, and post prandial blood sugar was found to be higher in diabetics subjects when compared to non- diabetic. HbA1C also found to be higher in diabetics. Blood sugar and serum creatinine increases in cases compared with the controls. Both blood urea and serum creatinine shows statistically significant value ($p < 0.001$).

Discussion

Diabetes mellitus is one of the most common metabolic disorders mainly caused due to defect in the secretion or action of insulin. [17] Mainly characterized by chronic hyperglycemia due to derangement of carbohydrates, fats, and protein metabolism. [18] This leads to the damage of various organs like eyes, kidneys, heart, nerves, and blood vessels. Throughout the world, Diabetes is one of the leading causes of morbidity and mortality and about 2.2 to 3% of world's population suffers with Diabetes recently and this proportion may even increase in the coming years. [19] In the 21st Century, Diabetes is one of the most challenging health problems affecting about 6-7% of world's population. About 170 million people are affected with Diabetes worldwide and this number may even increase to 438 million people by 2030. Dietary modification, genetic mutations, high blood pressure, smoking, obesity, high cholesterol levels and lack of exercise are the risk factors for increasing the risk of Diabetes. [20-22]

Out of 100 cases, we had 25 samples with increased Urea, 35 samples with more creatinine and 40 samples increased with both urea and creatinine when compared with controls. In our study group, males having more creatinine value compared to females due to presence of more muscle mass. Increased blood urea and serum creatinine values are observed in diabetic patients when compared with controls. There was no increase in blood urea and serum creatinine in controls.

Our study shows significant increase of blood urea and serum creatinine in diabetic patients which may be an indicative of pre-renal damage. This study was similar to the study of Sirivole MR et al as they explained the relationship of long-standing plasma glucose level with blood urea level.¹⁸ This was also similar to the study of Anjaneyulu M as they found increased urea and creatinine value in diabetic rats which leads to progressive renal damage. [23] As

our study shows increased level of blood urea and serum creatinine, it clearly indicates prolonged hyperglycemia which causes irretrievable damage to the nephrons of the kidney. The tiny filtering units of kidneys i.e., nephrons are damaged due to high blood sugar level. As the main function of kidney is to maintain the fluid electrolyte balance, this function got impaired. Increase in serum creatinine & blood urea is due to diminishing of GFR as the creatinine is an indirect measure of glomerular filtration and indicating reduced filtration capacity of the kidney. [18]

Mean fasting, and post prandial blood sugar was found to be higher in diabetics subjects when compared to non- diabetic. HbA1C also found to be higher in diabetics. Blood sugar and serum creatinine increases in cases compared with the controls. Both blood urea and serum creatinine shows statistically significant value ($p < 0.001$). Study observations found that blood glucose concentration, plasma creatinine and urea concentrations were noticed to be greater in type 2 DM subjects. [24-26] This showed that increased plasma creatinine and urea levels in diabetic patients would indicate a pre-renal disorder. A Saudi study carried out by Abdulrahman Aldukhayl in 2017 showed a comparison between many Arabian countries in regards to the prevalence of diabetic nephropathy clarifying that Iraq had a medium prevalence of DN while UAE had the highest prevalence when Bahrain had the lowest. [27]

Conclusion

In our study, there is a linear relationship of serum creatinine and blood urea with increased levels of HbA1C in Diabetes mellitus patients. Regulation of blood glucose level in proper time will prevent the Progression of Diabetes to Renal Impairment. So, these patients should be monitored regularly with glycemic control and renal failure to avoid the long-term complications of Diabetes Mellitus. By this we can say blood urea and serum creatinine are the simple and useful biomarkers which can serve as predictor tests for assessing the functions of the kidneys.

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