Section: Emergency Medicine

Original Research Article

CORRELATION OF HBA1C (NORMAL) IN EARLY AND WELL CONTROLLED DIABETES WITH SERUM CREATININE AND BLOOD UREA

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ABSTRACT

Background: Diabetes mellitus is a prevalent metabolic disorder characterized by chronic hyperglycemia, leading to complications affecting various organs, particularly the kidneys. This study aims to assess the correlation between glycemic control, as indicated by HbA1c levels, and renal function, measured through blood urea and serum creatinine levels, in diabetic patients with controlled diabetes compared to healthy controls.

Materials and Methods: A comparative case-control study was conducted involving 300 patients with well-controlled diabetes and 100 healthy age-matched controls. Key biochemical parameters, including fasting blood sugar (FBS), postprandial blood sugar (PPBS), HbA1c, blood urea, and serum creatinine, were analyzed. Statistical analysis was performed using Student's t-test to compare the two groups.

Results: Among the diabetic cases, 84 (28%) had elevated urea levels, 90 (30%) showed increased creatinine, and 126 (42%) had elevated levels of both. Males exhibited higher creatinine values than females, likely due to greater muscle mass. A significantly higher levels of FBS, PPBS, HbA1c, blood urea, and serum creatinine was observed in diabetic patients as compared to controls ($p < 0.001$).

Conclusion: Elevated blood urea and serum creatinine levels in diabetic patients are indicative of renal impairment. There is a significant correlation between poor glycemic control and kidney function deterioration. Regular monitoring of these parameters is crucial for the early detection and management of diabetic nephropathy, emphasizing the importance of glycemic control in preserving renal health.

Keywords: Diabetes mellitus, blood urea, serum creatinine, HbA1c, renal impairment, diabetic nephropathy.

INTRODUCTION

Diabetes mellitus is one of the most prevalent metabolic disorders, primarily caused by defects in insulin secretion or action.[1] It is characterized by chronic hyperglycemia, resulting from disturbances in carbohydrate, fat, and protein metabolism.[2] This condition leads to damage to multiple organs, including the eyes, kidneys, heart, nerves, and blood vessels.

Globally, diabetes ranks as a leading cause of morbidity and mortality, affecting approximately 2.2% to 3% of the population, with projections indicating an increase in the coming years.[3] In the 21st century, diabetes has emerged as one of the most pressing health issues, affecting around 6-7% of the global population. Currently, an estimated 170 million people are living with diabetes worldwide, a number expected to rise to 438 million by 2030. Several factors contribute to the increased risk of diabetes, including dietary habits, genetic predispositions, high blood pressure, smoking, obesity, high cholesterol, and lack of physical activity.[4-6]

Dyslipidemia, hypertension, and visceral adiposity are associated with Diabetes and these are the comorbid risk factors for developing chronic disease and cardiovascular disease.[7] End stage renal disease and diabetic nephropathy are mainly associated with renal disorders in diabetic patients. 8.25-45% of diabetic patients clinically develop diabetic nephropathy in their lifetime.[8]

Glycosylation of tissue proteins causes deterioration of the structure and function of kidney which finally leads to Diabetic nephropathy (DN). In many countries, DN affects 30% of all diabetics which is the leading cause of end stage renal disease (ESRD).[9–12] Abnormal renal functions like abnormal blood urea, serum creatinine and macro albuminuria are some of the characteristic features of Diabetic Nephropathy. In uncontrolled diabetes, there may be hyperglycemia associated abnormal increase of blood urea and serum creatinine. So, urea and creatinine are the two important factors to find any abnormality in the kidney.

Serum creatinine when it alters, there will be more reliable reflection in GFR whereas urea formation depends on factors like liver function, protein intake, and rate of degradation of proteins. So, measurement of blood urea and serum creatinine helps in the early detection and prevention of diabetic kidney diseases and prevents the progression of end stage renal disease.[13,14] As renal complications are more common in diabetic patients, we aimed to measure the blood urea and serum creatinine levels in diabetic patients and correlate these parameters in non-diabetic patients.

In advent of same the present study was undertaken with an aim to assess the correlation of HbA1c (normal) in early and well controlled diabetes with serum creatinine and blood urea.

MATERIALS AND METHODS

After receiving approval from the institutional ethics committee, this comparative case-control study was conducted in the Department of General Medicine at Index Medical College Hospital and Research Centre, Indore. The study included 300 male and female patients over the age of 18 with well-controlled diabetes as the case group, and they were compared with 100 healthy, age-matched individuals without a history of diabetes, who served as the control group. Written informed consent was obtained from all patients after explaining the study protocol, prior to their enrolment in the study.

Inclusion Criteria

- All patients of both genders aged more than 18 years;
- Study Group: Patients with well controlled diabetes mellitus were taken as cases.
- Control Group: Patients with normal blood glucose and normal renal functions tests are taken as controls; and
- Patients who consented to participate in the study

Exclusion Criteria

- Smokers, individuals with hypertension, hyperlipidemia, pregnant women, and those with other chronic disorders were excluded from our study; and
- Patients who didn't consented for the study.

Methodology

A detailed medical and personal history was obtained, along with a systemic examination. The variables collected included age, gender, fasting and postprandial blood glucose levels, HbA1C, blood urea, and serum creatinine for all subjects.

Blood samples were collected from both the case and control groups to assess key biochemical parameters such as blood urea, serum creatinine, fasting blood sugar (FBS), postprandial blood sugar (PPBS), and HbA1C. These parameters were analyzed in a clinical biochemistry laboratory using commercial kits adapted to an auto-analyzer. Serum was separated through centrifugation at 4,000 rpm for 10 minutes. Plasma glucose levels were measured using the glucose oxidase and peroxidase (GOD-POD) endpoint assay method. Blood urea was assessed via the enzymatic urease method, while serum creatinine was measured using the alkaline Jaffe's method. HbA1C levels were determined through the ion exchange resin method using a diagnostic kit. The results were expressed as mean ± SD.

Normal ranges were established as follows: fasting plasma glucose (70-110 mg/dl), postprandial glucose (<140 mg/dl), urea (15-40 mg/dl), and creatinine (0.6-1.4 mg/dl for males, 0.5-1.2 mg/dl for females), with HbA1C values of ≥6%. The WHO criteria were used to classify diabetes mellitus cases.

Statistical Analysis

The raw data was recorded on a Microsoft Excel spreadsheet and analyzed using IBM Statistical Package for Social Sciences (SPSS), version 22.0. The mean and standard deviation were used to compare continuous parametric data while meaning and interquartile range was used for continuous non-parametric data and percentages for categorical data. The data collected was analyzed using the Student's t-test to compare the significance between the diabetic and non-diabetic control groups. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The demographic distribution of our study included a total of 300 subjects in the study group, consisting of 216 (72%) males and 84 (28%) females, with ages ranging from 20 to 60 years and a mean age of approximately 55.2 + 10.1 years. 100 Age-matched controls were also included.

Among the 300 diabetic cases, 84 (28%) exhibited elevated urea levels, 90 (30%) showed increased creatinine levels, and 126 (42%) had elevated levels of both urea and creatinine compared to the controls. Notably, males demonstrated higher creatinine values than females, likely due to greater muscle mass. Overall, increased blood urea and serum creatinine levels were found in diabetic patients compared to the controls, who showed no elevation in these parameters. [Table 1]

In our study, the mean fasting and post-prandial blood sugar levels were found to be significantly higher in diabetic subjects compared to non-diabetic individuals. The HbA1C levels were also higher in diabetic patients, with blood sugar and serum creatinine levels showing significant increases in cases compared to controls. Both blood urea and serum creatinine exhibited statistically significant differences, with p-value <0.001. [Table 2]

Table 1: Presents the number of samples exhibiting elevated levels of blood urea and serum creatinine in both diabetic and non-diabetic groups

Parameters	Cases (N=50)	Control (N=50)
Increased Blood urea	84 (28%)	0 (0%)
Serum Creatinine increased	90 (30%)	0 (0%)
Both urea and creatinine increased	126 (42%)	0 (0%)
Total	50 (100%)	0 (0%)

Table 2: Presents the mean ± standard deviation (SD) of blood urea and serum creatinine levels, along with their correlation to fasting blood sugar (FBS), postprandial blood sugar (PPBS), and HbA1C values in both the diabetic cases and the control group

Parameters	Cases (N=300)	Control (N=100)	P value
FBS	181.20 ± 32.25	92.51 ± 9.25	0.000*
PPBS	271.10 ± 41.11	123.28 ± 6.43	0.000*
HbA1c	6.52 ± 0.03	5.16 ± 0.42	0.000*
Blood Urea	65.80 ± 12.22	27.64 ± 5.43	0.000*
Serum Creatinine	1.85 ± 0.79	0.83 ± 0.10	0.000*

DISCUSSION

Diabetes mellitus is a major global cause of mortality, and renal function impairment associated with diabetes can be evaluated by measuring blood urea and serum creatinine levels. Monitoring these parameters is crucial for the early detection of any kidney dysfunction.[15]

In our study, the presence of elevated blood sugar levels indicates poor glycemic control, which is a sign of renal nephropathy (RN). Glycemic control is closely associated with the risk of nephropathy and other complications related to diabetes. An increase in blood urea levels suggests kidney impairment or damage, while creatinine levels act as a marker for glomerular filtration rate (GFR). The concurrent rise in both creatinine and urea, along with elevated blood sugar levels, clearly indicates kidney damage.[7]

Our study demonstrates a significant increase in blood urea and serum creatinine levels in diabetic patients, suggesting potential pre-renal damage. This finding aligns with the research of Rao M et al., who highlighted the correlation between prolonged plasma glucose levels and blood urea levels.[2] Similarly, the study by Anjaneyulu M and Chopra R et al. reported elevated urea and creatinine levels in diabetic rats, indicating progressive renal damage.[16]

Our study indicates that elevated levels of blood urea and serum creatinine are clear signs of prolonged hyperglycemia, which leads to irreversible damage to the kidney's nephrons. High blood sugar levels harm the tiny filtering units of the kidneys, impairing their primary function of maintaining fluid and electrolyte balance. The increase in serum creatinine and blood urea is attributed to a decrease in glomerular filtration rate (GFR), as creatinine serves as an indirect measure of GFR, reflecting the reduced filtration capacity of the kidneys.[2]

Intensive treatment can effectively lower elevated levels of HbA1c; however, increased levels of blood urea and serum creatinine are often irreversible due to permanent kidney damage associated with diabetes mellitus (DM).[7] This study suggests that blood urea and serum creatinine serve as prognostic markers and predictors of renal damage in diabetic patients. This was in concurrence with findings of study done by Aldler AI et al.[17]

The study's limitations include a relatively small sample size, which may affect the generalizability of the findings, and the cross-sectional design, which limits the ability to establish causal relationships between glycemic control and renal impairment. Additionally, potential confounding factors such as diet, medication adherence, and duration of diabetes were not controlled for, which may influence the results.

CONCLUSION

In conclusion, our study demonstrates that elevated levels of blood urea and serum creatinine in patients with diabetes mellitus are indicative of renal impairment and highlight the significant relationship between poor glycemic control, as reflected by HbA1c levels, and kidney function deterioration.

Regular monitoring of these parameters is essential for early detection and management of diabetic nephropathy, as timely intervention can prevent the progression of renal damage and reduce the risk of long-term complications associated with diabetes. Thus, blood urea and serum creatinine serve as effective biomarkers for assessing renal health in diabetic patients, reinforcing the importance of glycemic control in preserving kidney function.

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Conflict of Interest: The authors declare no conflict of interest.

Ethical Considerations: Approval was taken from institutional ethical committee. Written informed consent was obtained from all patients after explaining the study's protocol.

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