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A Comparative Analysis of Serum Creatinine and Urea in Diabetic and Non-Diabetic Individuals

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ABSTRACT

Introduction: Diabetes mellitus poses a significant global health challenge due to its implications on various organ systems, particularly kidney function. This study aimed to evaluate serum urea, serum creatinine, and blood sugar levels in individuals (diabetic and non-diabetic), exploring their interrelationships and implications in diabetic nephropathy.

Materials and Method: Fifty diabetic and twenty non-diabetic participants were assessed for three months at Bhima Bhoi Medical College and Hospital in Balangir, Odisha, India. Blood samples were collected for urea, creatinine, and blood sugar analysis. Statistical computations were performed to analyze correlations and associations among these biomarkers.

Results: Strong positive correlations were found between blood sugar and serum urea levels in diabetic patients, suggesting a link between glycemic control and kidney function. Serum urea and creatinine emerged as promising markers for assessing renal damage in diabetes. Notably, gender-specific differences in serum creatinine levels were observed, warranting further investigation.

Conclusion: Effective blood sugar management plays a crucial role in preventing diabetic nephropathy. Serum urea and creatinine serve as valuable indicators for monitoring kidney function in diabetes. The study underscores the significance of assessing renal health and

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functioning tests in managing type 2 diabetes and advocates for further research to enhance diabetes care strategies.

Keywords - Diabetes mellitus, Serum creatinine levels, Renal function, Neuropathy, biomarkers

INTRODUCTION

Diabetes mellitus is a persistent metabolic disorder characterized by elevated blood sugar levels, resulting from either inadequate insulin production by the pancreas, insufficient utilization of insulin by the body's cells, or both [1]. This condition leads to abnormalities in carbohydrate, fat, and protein metabolism. The sustained high levels of blood glucose, known as hyperglycemia, are associated with various long-term complications affecting multiple organ systems, such as the eyes, kidneys, nerves, and cardiovascular system [1]. Types of diabetes mellitus include Type 1, where there is a lack of insulin production, and Type 2, where the body's cells become resistant to insulin or fail to utilize it effectively. Management of diabetes involves lifestyle modifications, medication, insulin therapy, and regular monitoring of blood glucose levels to prevent complications and maintain optimal health [2]. Severe complications of diabetes mellitus include cardiovascular problems like heart disease and stroke, nerve damage leading to “neuropathy”, kidney impairment (nephropathy). Additionally, extreme cases may involve “diabetic ketoacidosis” (DKA) or “hyperosmolar hyperglycemic state” (HHS), both potentially life-threatening conditions due to extremely high blood sugar levels [2].

“Diabetes nephropathy”, a complication arising from prolonged diabetes, primarily affects the kidney's glomeruli, the pivotal structures responsible for filtration. “Diabetes Mellitus” exerts a destructive effect on the kidney's delicate filtering system over time. Initially, this system becomes compromised, permitting larger blood proteins like albumin to escape into the urine, a condition known as “proteinuria” [3]. This leakage serves as an early indicator of kidney damage in diabetes. Notably, the risk of such damage heightens with poorly controlled blood sugar levels. As diabetes persists, this initial leakage progresses, leading to the development of more severe conditions such as nephrotic syndrome, characterized by significant protein loss in urine, swelling, and high cholesterol. Ultimately, chronic renal failure can ensue, marking advanced kidney damage and compromised kidney function [3, 4].

Regular monitoring of blood sugar levels, blood pressure, and kidney function is crucial in managing diabetes to prevent or delay the onset and progression of diabetes nephropathy. Early

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intervention, including lifestyle modifications and medication, plays a pivotal role in mitigating the risk of kidney complications in individuals with diabetes [4].

Elevated levels of urea and creatinine in the blood indicate decreased kidney function or impaired filtration. When the kidneys are functioning properly, they efficiently filter these waste products out of the bloodstream, keeping their levels within a normal range. However, if the kidneys are not working optimally, urea and creatinine accumulate in the blood, indicating reduced kidney function, hence the measuring the levels of creatinine and urea is considered a test for evaluating the renal function [4]. This test helps in diagnosing and monitoring various kidney conditions, including chronic kidney disease, acute kidney injury, or other disorders affecting renal function. It provides valuable insights into the kidneys' ability to effectively filter waste products from the blood [5]. Additionally, the ratio of urea to creatinine levels can sometimes offer further information about the cause of kidney impairment, aiding healthcare professionals in determining appropriate treatment and management strategies for kidney-related issues [5]. The research intends to assess serum urea and creatinine levels in both diabetic and non-diabetic samples and determine a correlation between glucose levels and urea as well as creatinine in blood.

MATERIALS AND METHODS

The study was conducted at Bhima Bhoi Medical College and Hospital in Balangir, Odisha, India. 50 diabetic samples were considered for the research and 20 non- diabetic samples were taken as control. The samples were assessed for three months in the Pathology Department of the Medical college. Diabetes was diagnosed under the norms of WHO and the patients enrolled for the study were within the age of 30-60. Participants with urinary tract blockage, congestive heart failure, alternative long-term kidney conditions, “muscular dystrophy” were not included in the study. An informed written consent and agreement form was signed by the patients before the study was initiated.

10 ml of blood sample was collected from each participant for analysis of urea level, blood sugar and creatinine serum levels. Blood glucose level was estimated by "Glucose Oxidase-Peroxidase method”, whereas urea was analyzed by “Urease Berthelot’s method” and, with the help of “Jaffe’s Method”, serum creatinine was analyzed [6, 7]. Standard deviations for glucose, serum creatinine and urea were computed.

RESULT

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As mentioned in Table 1, total number of participants in the research study was 70 (50 Diabetic and 20 Non-diabetic), 35 males and 35 females. For the control, out of 20 non-diabetic participants, all of them had normal levels of urea, 1 out of 20 had slightly elevated levels of serum creatinine. Control patients who have abnormal levels of creatinine can be because of more muscle mass or higher than usual protein intake. When diabetic patients were investigated out of 50 patients, 10 patients had abnormal levels of urea levels. 4 of them had elevated levels of serum creatinine.

Table 1: Analysis of creatinine and urea levels in diabetics and non-diabetic categories

Categories	*Diabetic Patients (N=50)*	*Non-Diabetic Patients (N=20)*
Urea	10	0
Serum Creatinine	4	1

Table 2- Blood analysis in diabetic patients compared to healthy controls

Categories	*Diabetic Patients*	*Non-Diabetic Patients*
Urea Levels	19.23±5.75	26.99±21.23
Serum Creatinine	0.99±0.02	1.17±0.87
Blood Sugar (fasting)	86.02±7.98	135.33±69.87
Blood Sugar (post lunch)	130.67±8.09	169.22±75.44

In a comprehensive comparison between diabetic and non-diabetic cohorts in table 2 above, several distinctions emerged. Diabetic patients were presented with significantly lower urea levels (19.23 ± 5.75 mg/dL) than non-diabetic individuals (26.99 ± 21.23 mg/dL). However, diabetic patients displayed slightly lower serum creatinine levels (0.99 ± 0.02 mg/dL) compared to non-diabetic counterparts (1.17 ± 0.87 mg/dL). Regarding blood sugar levels, both fasting and post-lunch measurements were notably lower in the diabetic group. Diabetic patients exhibited an average fasting blood sugar of 86.02 ± 7.98 mg/dL, contrasting with the non-diabetic group at 135.33 ± 69.87 mg/dL. Similarly, post-lunch blood sugar levels were substantially lower in diabetics (130.67 ± 8.09 mg/dL) compared to non-diabetic individuals (169.22 ± 75.44 mg/dL).

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There was a notably strong positive relationship observed between urea levels and blood glucose levels in both cases (Post meal and fasting). This correlation suggests that as blood sugar levels increase, so do serum urea levels. Conversely, a weaker relationship was found between creatinine and glucose levels, indicating a less pronounced relationship between these variables. When examining the impact of gender on these parameters, non-significant relationships and negative correlations were observed between blood sugar levels, serum urea, and gender. These findings imply that while serum urea and blood sugar levels exhibit significant positive correlations, other parameters such as serum creatinine levels display weaker associations, with gender playing a negligible role in these relationships.

DISCUSSION

The study conducted at Bhima Bhoi Medical College and Hospital aimed to evaluate urea, glucose levels and creatinine levels in diabetic and non-diabetic individuals. The findings shed light on distinctive patterns and correlations among these parameters, offering insights into diabetic-related kidney function and blood glucose regulation. The most promising observation was the marked positive association between urea levels and glucose levels in post meal and fasting tests. Our research highlights that inadequate management of blood sugar levels leads to elevated serum urea levels, potentially heightening the risk of diabetic nephropathy in patients. This aligns with previous studies indicating that high blood sugar levels contribute significantly to the progression of renal damage in diabetes [6, 7]. This robust association suggests a direct correlation between elevated glucose levels and high urea levels. The findings indicate that fluctuations in blood glucose levels might directly impact urea levels, potentially reflecting kidney function in diabetic individuals [6].

Contrarily, serum creatinine levels displayed weaker positive correlations with blood sugar levels, particularly in the overall study population. However, an intriguing gender-based observation revealed a closer positive relationship between glucose and serum creatinine levels in males. This might be because of the higher protein intake by male candidates. Elevated urea levels typically indicate kidney damage. In diabetic patients, high blood sugar levels coupled with increased blood urea levels signify potential kidney impairment [8]. Previous studies conducted on diabetic rats have indicated that rising levels of urea and serum creatinine correlate with the progression of renal damage [7, 8]. In our research, we observed a strong correlation of the duration of diabetes,

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its severity and serum urea levels, while this association was less pronounced with creatinine levels. This aligns with the understanding that creatinine and urea levels serve as markers of "Glomerular Filtration Rate" (GFR). Serum creatinine, being a more ideal and sensitive marker of renal health and function than urea, fulfills most of the criteria for an ideal filtration marker [8, 9]. No correlation was found between gender and blood sugar levels, similarly, a significant link between gender and urea levels was also absent. Prior research conducted by scientists yielded comparable findings [9, 10]. Our study outcomes align with previous research indicating that elevated urea and serum creatinine levels in diabetic candidates might signal an early renal issue [10, 11].

Serum creatinine and urea levels serve as the most crucial "prognostic markers" and predictors for renal disorders and damages in diabetic candidates [12]. Controlling the blood sugar levels can halt the growth towards "diabetic nephropathy", significantly reducing the associated morbidity and mortality. Conducting renal function tests and analyzing it is a straightforward, dependable, cost-effective approach that is now regarded as an additional tool in treating and providing long-term care for Diabetes mellitus type 2 [13, 14].

CONCLUSION

In conclusion, our study highlights the robust correlation between blood glucose levels and urea levels in diabetic patients, indicating a potential link between glycemic control and kidney function. Urea and serum creatinine serve as valuable markers for monitoring renal damage in diabetes. Effective blood sugar management is crucial in preventing diabetic nephropathy. Gender-specific differences in serum creatinine levels warrant further investigation. Assessing renal function tests, specifically in serum creatinine and urea, helps in tackling Type 2 Diabetes Mellitus. Further research into these relationships can enhance diabetes care strategies.

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