Study of Correlation Between Serum Urea, Uric Acid Levels and Blood Pressure Variations in Diabetic Patients

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ABSTRACT

Background:

According to the World Health Organization (WHO), around 830 million people suffer from diabetes mellitus around the globe. According to reports in the year 2017, around 9 million individuals had been suffering from Type 1 diabetes, which will go up to nearly 13.5 to 17.4 million in 2024. Diabetes mellitus and hypertension are intimately related diseases, frequently coexisting and significantly raising the chances of developing cardiovascular and renal problems. Diabetes is characterized by persistent high glucose concentrations in the blood, causing endothelial injury, artery stiffness, and stimulation of the renin-angiotensin-aldosterone pathway, which ultimately results in an increase in blood pressure. The development of insulin resistance further contributes to sodium retention and sympathetic nervous system activation, increasing blood pressure.

Material and Methods:

The study was conducted on 130 patients with diabetes mellitus attending outpatient and inpatient departments at NIMS Hospital Rajasthan Jaipur. Participants were selected based on predefined inclusion and exclusion criteria. Clinical data, including demographic details, medical history, and lifestyle factors, were recorded using a structured proforma. Blood samples were collected, and serum urea and uric acid levels were estimated using standard laboratory methods. Data were analysed using Microsoft Excel and SPSS software.

Results:

In the study, majority of the patients 92 out of 130 (70%) were male and the major study population age grouping was 51-60 years with (26%). The correlation of serum urea (0.0002) and serum uric acid (0.0093) were significantly correlated with systolic blood pressure and significant between serum urea and serum uric acid (0.0002).

Conclusion:

The present study was conducted to assess the relationship between serum urea, uric acid levels, and blood pressure among diabetic patients. The findings demonstrate that the majority of participants were middle-aged, with a higher prevalence among males, and most exhibited blood pressure levels within the prehypertensive range. A significant positive correlation was observed between serum urea levels and systolic blood pressure, indicating that increasing serum urea is associated with elevated systolic blood pressure in diabetic patients. This suggests

that renal dysfunction may play an important role in the development of hypertension in individuals with diabetes mellitus.

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Introduction: Diabetes mellitus, often called diabetes, is a serious and long-term metabolic disorder. It is marked by consistently high blood glucose levels. This happens either because the body doesn't produce enough insulin or because it can't use the insulin effectively. It affects people of all ages, genders, and areas around the world. This makes it a significant factor in global illness and death. Both genetics and environmental factors contribute to the development of type 2 diabetes, which makes up over 90% of all cases [(1)]. It impacts individuals regardless of age, gender, or geographical location. This explains why it is a critical determinant of worldwide morbidity and mortality [(2)]. Genetic and environmental elements play a role in the occurrence of type 2 diabetes mellitus, which accounts for more than 90 percent of all diabetes mellitus cases [(1)].

According to the World Health Organization (WHO), around 830 million people suffer from diabetes mellitus around the globe. According to reports in the year 2017, around 9 million individuals had been suffering from Type 1 diabetes, which will go up to nearly 13.5 to 17.4 million in 2024. Moreover, according to WHO, in the year 2022, around 14% of adults aged 18 years and older suffered from Type 2 diabetes. Around the world, in the USA, statistics released by ADA and CDC revealed that around 11.6%, or 38.4 million people, suffered from diabetes in the year 2021. [(3)]

Hypertension is a multifactorial disease that arises as a consequence of physiological changes within the cardiovascular system. Hypertension may be caused by an increased cardiac output, by an increased peripheral vascular resistance, or both. Blood pressure is regulated by several means, such as neural control, endocrine, and renal control; and an imbalance in any of these may lead to hypertension. [4].

Diabetes mellitus and hypertension are intimately related diseases, frequently coexisting and significantly raising the chances of developing cardiovascular and renal problems [(5)]. Diabetes is characterized by persistent high glucose concentrations in the blood, causing endothelial injury, artery stiffness, and stimulation of the renin-angiotensin-aldosterone pathway, which ultimately results in an increase in blood pressure [(6)]. The development of insulin resistance further contributes to sodium retention and sympathetic nervous system activation, increasing blood pressure [(7)]. Furthermore, diabetes mellitus is associated with the development of diabetic nephropathy, causing dysfunction of the kidneys, fluid retention, and hypertension. However, hypertension exacerbates the complications of diabetes mellitus, creating a vicious cycle [(8)].

In conclusion, the present study demonstrates that serum urea shows a significant positive association with systolic blood pressure in patients with diabetes mellitus, indicating a possible link between renal function impairment and hypertension. Although uric acid did not exhibit a significant relationship with blood pressure, its positive correlation with serum urea suggests its relevance in the overall metabolic profile of diabetic patients. These findings emphasize the importance of routine monitoring of renal and biochemical parameters for early identification of complications. Early detection and timely management may help reduce the risk of disease progression and improve the overall clinical outcomes in individuals with diabetes mellitus.

Methodology: This cross-sectional study was conducted over a period of six months at NIMS Hospital, Jaipur, Rajasthan, after obtaining approval from the Departmental Research Committee (DRC). A total of 130 clinically diagnosed diabetic patients were included based on predefined inclusion and exclusion criteria, and informed consent was obtained from all participants. Venous blood samples (3–5 mL) were collected under aseptic conditions after overnight fasting. The samples were allowed to clot and then centrifuged to separate serum, which was used for the estimation of serum urea, serum uric acid, and HbA1c using standard biochemical methods. All analyses were performed using a fully automated analyser (VITROS-5600).

Serum urea was estimated by the urease method, and uric acid by the uricase method. HbA1c was measured using immunoturbidimetric/ion-exchange methods. Blood pressure was recorded using standard procedures.

Data were analysed using Microsoft Excel and SPSS software. Descriptive statistics (mean, standard deviation, frequency, and percentage) and inferential statistics (Karl Pearson's correlation coefficient) were applied. A p-value < 0.05 was considered statistically significant.

Selection Criteria: Clinically diagnosed diabetic patients of all age groups and both sexes were included in the study. Only those patients who provided informed consent were enrolled.

Inclusion criteria: Patients with chronic kidney disease (CKD) or known renal failure were excluded from the study. In addition, pregnant or lactating women and patients with a history of gout or hyperuricemia not related to diabetes were also excluded.

Results: A total of 130 diabetic patients were included in the study as shown in the figure no.1. The majority of participants were in the age group of 51–60 years (26.92%), followed by 41–50 years (23.08%). The mean age was 49.92 ± 13.46 years. Male participants predominated (70.77%) compared to females (29.23%).

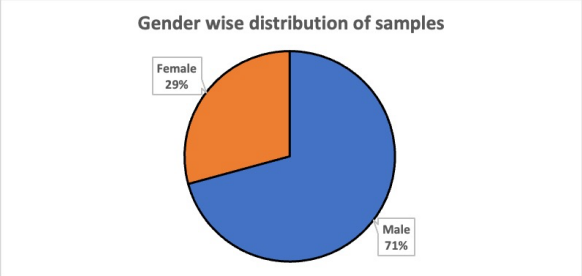

Figure No.-2 Frequency distribution of gender of samples

Regarding blood pressure, most subjects had systolic BP in the range of 120–139 mmHg (62.31%) and diastolic BP in the range of 70–79 mmHg (37.69%). The mean systolic and diastolic BP were 124.4 ± 17.5 mmHg and 73.36 ± 10.1 mmHg, respectively.

Most participants had normal serum urea levels (71.54%), while 13.85% and 14.62% showed mild and moderate elevation, respectively. Uric acid levels were within normal range in 53.85% of subjects, while the remaining showed varying degrees of elevation.

The mean biochemical values were: HbA1c 8.03 ± 1.49%, serum urea 38.96 ± 17.33 mg/dL, and uric acid 5.98 ± 1.95 mg/dL.

The Correlation analysis showed a moderate positive and statistically significant correlation between serum urea and systolic blood pressure ($r = 0.317$, $p < 0.001$) as shown in Table no.2. However, no significant correlation was found between serum urea and diastolic BP ($p > 0.05$). Uric acid did not show a significant correlation with either systolic or diastolic BP. A weak but significant positive correlation was observed between serum urea and uric acid levels ($r = 0.227$, $p < 0.01$).as shown in the table no.2.

Table no.2 Correlation of serum urea with uric acid by using Karl Pearson's correlation coefficient

Variables	Sr. Urea Corr (r)	t - test	P - Value	Significance
Uric Acid (mg/dL	0.227	2.639	0.0093	Significant

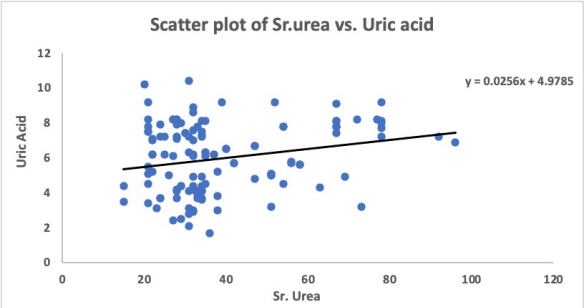

Figure:2 Correlation of serum urea with uric acid by using Karl Pearson's correlation coefficient

Discussion:

The present study was conducted to evaluate the correlation between serum urea, uric acid levels, and blood pressure among diabetic patients. A total of 130 participants were included, and the findings provide important insights into the relationship between renal biochemical parameters and hypertension in diabetes mellitus. In the present study, the majority of participants belonged to the middle-aged group (41–60 years), with a mean age of 49.92 ± 13.46 years. This finding is consistent with previous studies, which have reported that type 2 diabetes mellitus is more prevalent among middle-aged and elderly individuals due to factors such as sedentary lifestyle, obesity, and genetic predisposition. A male predominance (70.77%) was observed in this study, which is in agreement with earlier studies suggesting a higher prevalence of diabetes and associated complications among males,

possibly due to lifestyle factors and healthcare-seeking behaviour.

Regarding blood pressure, most participants had systolic blood pressure in the range of 120–139 mmHg and diastolic blood pressure between 70–89 mmHg, indicating a high prevalence of prehypertension among diabetic patients. This supports the well-established association between diabetes mellitus and hypertension, where insulin resistance, endothelial dysfunction, and activation of the renin-angiotensin-aldosterone system contribute to increased blood pressure levels.

In terms of biochemical parameters, the majority of participants had normal serum urea levels (71.54%), while a smaller proportion showed mild to moderate elevation. Similarly, 53.85% of participants had normal uric acid levels, with the remaining showing varying degrees of elevation. These findings suggest that although many diabetic patients maintain normal biochemical values, a significant proportion shows early signs of renal involvement and metabolic imbalance. The key finding of this study was the statistically significant positive correlation between serum urea and systolic blood pressure ($r = 0.317$, $p < 0.001$). This indicates that as serum urea levels increase, systolic blood pressure also tends to rise. This relationship may be explained by impaired renal function in diabetic patients, leading to reduced glomerular filtration rate, fluid retention, and increased vascular resistance, ultimately resulting in elevated blood pressure. Similar findings have been reported in previous studies, which highlight the role of renal dysfunction in the development of hypertension among diabetic individuals.

However, no significant correlation was observed between serum urea and diastolic blood pressure. This suggests that serum urea may have a stronger association with systolic rather than diastolic blood pressure, possibly due to differences in the physiological mechanisms regulating systolic and diastolic pressures.

In contrast, uric acid did not show a statistically significant correlation with either systolic or diastolic blood pressure in the present study. This finding is inconsistent with some previous studies, such as those by Sundström et al., which reported a positive association between uric acid and hypertension. The lack of significant association in this study may be attributed to factors such as sample size, variation in patient characteristics, dietary habits, or the influence of medications.

Interestingly, a weak but statistically significant positive correlation was observed between serum urea and uric acid levels ($r = 0.227$, $p < 0.01$). This suggests a possible link between these two biochemical parameters, likely due to their shared dependence on renal excretion. Impaired kidney function in diabetic patients may lead to the accumulation of both urea and uric acid in the blood.

The findings of this study have important clinical implications. Monitoring serum urea levels in diabetic patients may help in early identification of individuals at risk of developing hypertension and renal complications. Although uric acid did not show a significant association with blood pressure in this study, its role in metabolic and cardiovascular disorders cannot be overlooked. Serum urea showed as shown in the table no.3 and figure no.3 statistically significant positive correlation with systolic blood pressure ($r = 0.317$, $t = 3.784$, $p = 0.0002$). However, no significant correlation was observed between serum urea and diastolic blood pressure ($r = 0.015$, $t = 0.173$, $p = 0.8629$).

Table 3: Correlation of serum urea with systolic & diastolic BP by using Karl Pearson's correlation coefficient

Variables	Sr. Urea Corr (r)	t - test	P - Value	Significance
Systolic BP (mmHg)	0.317	3.784	0.0002	Significant
Diastolic BP (mmHg)	0.015	0.173	0.8629	Not significant

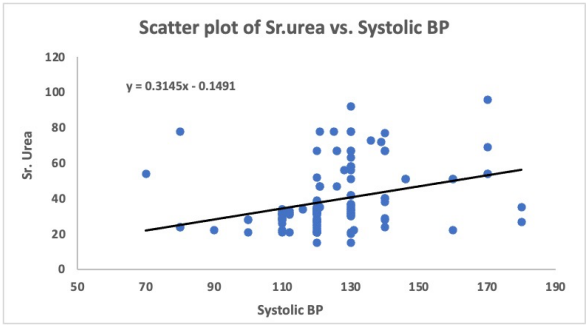

Figure 3: Correlation of serum urea with systolic & diastolic BP by using Karl Pearson's correlation coefficient

Conclusion: The present study was conducted to assess the relationship between serum urea, uric acid levels, and blood pressure among diabetic patients. The findings demonstrate that the majority of participants were middle-aged, with a higher prevalence among males, and most exhibited blood pressure levels within the prehypertensive range.

A significant positive correlation was observed between serum urea levels and systolic blood pressure, indicating that increasing serum urea is associated with elevated systolic blood pressure in diabetic patients. This suggests that renal dysfunction may play an important role in the development of hypertension in individuals with diabetes mellitus. However, no significant correlation was found between serum urea and diastolic blood pressure.

In contrast, uric acid levels did not show a statistically significant association with either systolic or diastolic blood pressure. Nevertheless, a weak but significant positive correlation was identified between serum urea and uric acid levels, suggesting a possible link due to shared renal excretory mechanisms.

Overall, the study highlights the clinical importance of monitoring serum urea levels as a potential indicator for hypertension risk in diabetic patients. Although uric acid was not significantly associated with blood pressure in this study, its role in metabolic and cardiovascular health remains relevant. Further large-scale and longitudinal studies are recommended to validate these findings and better understand the underlying mechanisms.

Limitation of the study

Despite its strengths, the present study has certain limitations. It was conducted as a cross-sectional study at a single centre with a relatively small sample size, which may limit the generalizability of the findings. Additionally, other confounding factors such as diet, duration of diabetes, and medication use were not fully controlled.

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