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Original Research Article

A Correlation of Urine Albumin Creatinine Ratio and Serum Cystatin C Levels as An Early Diagnostic Marker for Diabetic Nephropathy

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Abstract:

Diabetic nephropathy (DN) is one of the major health issues associated with type 2 diabetes mellitus (T2DM). T2DM is a major risk factor for end-stage renal disease (ESRD) and chronic kidney disease. Blood urea, urine albumin, creatinine, and serum cystatin C are common markers for the diagnosis and progression of DN. Our aim was to com- pare the levels of serum Cystatin C and other renal parameters in patients with diabetes mellitus (DM) and DN which included 120 participants were recruited based on the inclusion and exclusion criteria; of these, 60 were suffering from type-2DM and the remaining 60 were from DN. After taking the case history, the blood and urine samples were collected and sent to the laboratory for estimation of FBS and PPBS, blood urea, serum creatinine, serum cystatin C, and urine albumin creatinine ratio. Every participant in this study had higher blood glucose levels than usual. When both groups were compared, patients with DN showed higher levels of blood urea, serum creatinine, serum cystatin C, and urine albumin creatinine ratio than those with DM.

Conclusion is that levels of blood urea, creatinine, serum cystatin C, and urine albumin creatinine ratio were found to be higher in patients with diabetic nephropathy as compared to DM patients. Similarly, a positive correlation was found between the urine albumin creatinine ratio and serum cystatin C levels, so it can be considered an early diagnostic marker for diabetic nephropathy.

Keywords: Blood Glucose, Diabetes Mellitus, Diabetic Nephropathy, Serum Cystatin.

Introduction

Diabetes mellitus is a metabolic disorder that can result from inadequate insulin production, reduced insulin effectiveness, or a combination of both. Inadequate insulin levels can cause disturbances in the metabolism of carbohydrates, fats, and proteins [1,2,3]. DM ranks fourth or fifth among the world's most frequent non- communicable diseases and cause of death [4]. In 2000, it was estimated that 171 million people had diabetes [5]. By the year 2030, it is projected that approximately 366 million individuals, accounting for 4.4% of the global population, will be affected by diabetes. Among the various complications associated with diabetes mellitus (DM), diabetic nephropathy (DN) is a significant contributor to the development of chronic renal failure [6,7]. People with diabetes mellitus are 10 times more likely to develop end-stage renal failure, as stated by the International Diabetes Federation (IDF). It is estimated that approximately 40% of individuals with diabetes may eventually experience this condition.

Blood urea, urine albumin, serum creatinine, and estimated glomerular filtration rate (eGFR) are common markers for the diagnosis and advancement of diabetic nephropathy (DN) [8,9]. Micro-albuminuria is an early indicator of diabetic nephropathy [10]. Consequently, urinary albumin serves as a reliable indicator for chronic kidney disease. Cystatin C, on the other hand, is a non-glycosylated, basic protein with a low molecular weight of 13 kD [11]. Cystatin C can be found in various body fluids, such as milk, seminal plasma, and CSF. The kidneys play a crucial role in eliminating over 90% of Cystatin C through glomerular filtration without any hindrance. As a result, the kidneys are primarily responsible for breaking down Cystatin C. Due to its complete removal from circulation through glomerular filtration and proximal tubule reabsorption, Cystatin C has been suggested as a potential early diagnostic tool for glomerular injury [12]. Therefore, in the present study, serum cystatin C was taken along with blood urea, serum creatinine, and urine albumin

creatinine ratio as early diagnostic markers for the detection of diabetic nephropathy.

Materials and Methods

This is hospital-based study was conducted in the Department of General Medicine in American International Institute of Medical Sciences, Udaipur from June 2024 to August 2025. The study was conducted after approval from institutional ethical committee. 120 diabetic patients were involved in the study. Out of 120 participants, 60 were suffering from type 2 DM and rests were from diabetic nephropathy.

Inclusion Criteria: Type 2 DM adult patients of both sexes, age group 30–80 years and subjects with early diabetic nephropathy

Exclusion Criteria: Patients with symptoms suggestive of urinary tract infection. Patients with history of chronic illness like coronary heart disease, liver disease, tuberculosis, psychiatric problem and malignancy, pregnant and lactating, patients taking nephrotoxic drugs, patients who are not willing to give informed consent.

Blood sample from all study participants was collected and sent to laboratory for estimation of fasting blood glucose and postprandial blood glucose, blood urea, serum creatinine, serum cystatin-C and urine albumin creatinine ration. Data was collected and analyzed by SPSS software version 26. Results were expressed as Mean± standard deviation and p value >0.05 was considered to be statistically significant.

Following the estimation of biochemical parameters, the data from both the groups was collected and imputed into MS Excel. Subsequently, the data went analysis using unpaired 't" test through SPSS software version 26.0. The results were expressed as mean ± SD (standard deviation), with a significant level of $p<0.05$.

Results

In the present study,120 study participants were recruited; 60 were diabetic patients, and the rest were patients with diabetic nephropathy (DN). 45.5% of the study population belonged to the age group 51–60 years, 32.5% belonged to the age group 41-50 years, 16.66% were in the age range of 31-40 years, and the rest, 8.33%, were above 61 years (Figure 1). Overall, 61.66% (n = 74) of study participants were males, and the rest were females (38.33%).

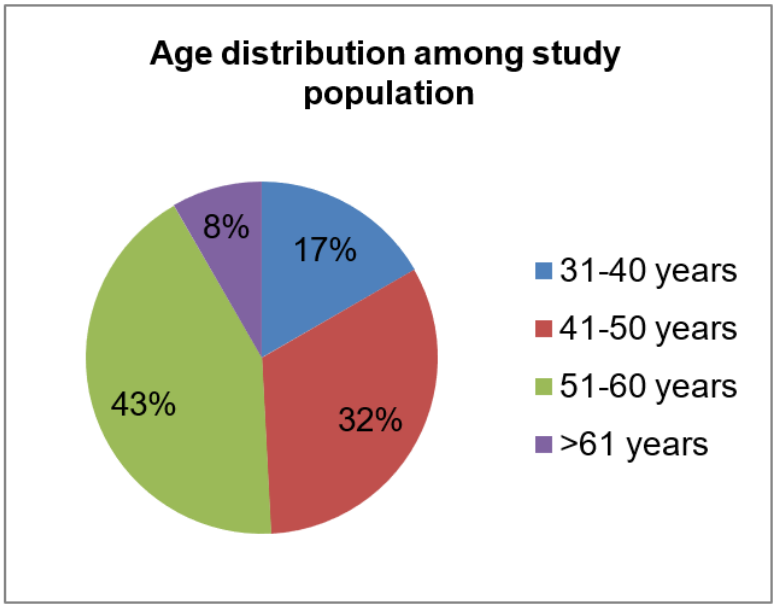

Fig 1: Distribution of participants according to age

Table 1: Blood glucose level in patients of diabetes mellitus and diabetic nephropathy

Variables	Diabetes mellitus	Diabetic nephropathy	Mean difference	P-value
FBS (mg/dl)	145.6 ± 23.7	182.9 ± 52.8	37.3±29.1	<0.05
PPBS (mg/dl)	207.75 ± 51.8	265.35±73.34	57.6±21.54	<0.05
P<0.05 statistically significant				

In the present study, all the participants showed higher levels of FBS and PPBS. When a comparison was done between the groups, patients with diabetic nephropathy showed higher levels of FBS and PPBS, which was statistically significant ($p<0.05$) (Table 1). The mean serum urea levels (23.95 mg/dl) were normal in patients with diabetes mellitus but

higher in patients with diabetic nephropathy (51.46 mg/dl).

When comparison was done between the groups, a significant difference was observed ($p<0.05$). Although the patients with diabetic nephropathy have also shown higher levels of serum creatinine (1.50±0.28 mg/dl), urine albumin creatinine ratio (263.86 ±39.0 mg/gm), and serum cystatin C (1894.97± 369.89 ng/ml) as compared with diabetic patients (serum creatinine 0.73±0.14 mg/dl; urine albumin creatinine ratio 28.56 ± 1.34 mg/gm; serum cystatin-C1174.56 ± 194.68 ng/ml), which was statistically significant ($p<0.05$).

Table 2: Serum creatinine, urea and cystatin C levels in patients of diabetes mellitus and diabetic nephropathy

Variables	Diabetes mellitus	Diabetic nephropathy	Mean difference	P-value
Serum creatinine (mg/dl)	0.73±0.14	1.50±0.28	0.77±0.14	<0.05
Serum urea (mg/dl)	23.95±10.81	51.46±13.45	27.51±2.64	<0.05
Urine Albumin Creatinine Ratio (mg/gm)	28.56±1.34	263.86±39.0	235.3±37.66	<0.05
Serum cystatin-C (ng/ml)	1174.56± 194.68	1894.97± 369.89	720.41± 175.21	<0.05
P<0.05 = statistically significant				

Table 3: Correlation between serum cystatin C and urine albumin creatinine ratio between patients of diabetic nephropathy and diabetes mellitus

Correlation between	Diabetic nephropathy	Diabetes mellitus
r value	0.3	-0.09
p value	<0.0001	<0.0001

In patients of diabetes mellitus and diabetic nephropathy, the correlation between serum cystatin C and albumin creatinine ratio was analyzed using Pearson's correlation analysis. There was a positive correlation found between both parameters, but which was only statistically significant in patients with diabetic nephropathy (r value= 0.3, p value ≤ 0.0001) (Table 3).

Discussion

The aim of the present study was to compare serum cystatin C levels in patients with diabetes mellitus and diabetic nephropathy and to correlate them with urine albumin creatinine ratio as early diagnostic markers for the detection of diabetic nephropathy. Micro-albuminuria, or DN linked to significant glomerular damage, is considered an initial indicator of renal dysfunction in individuals with type 2 DM. DN is the leading cause of end- stage renal disease, and hyperglycemia plays a significant role in its development. In patients with type 2 DM, diabetic nephropathy is the primary microvascular complication leading to morbidity and mortality.

In the present study, the majority of the study population (45.5%) belonged to the age group 51–60 years, followed by 32.5% who belonged to the age group 41–50 years (Figure 1). The present study reveals that the prevalence of diabetes mellitus is increasing with age; the same thing was expressed in another study [13,14]. It may be due to the decreased secreting capacity of pancreatic β cells.

In the present study, patients of both groups showed a rise in fasting and postprandial blood sugar levels above normal. When comparison was done between groups, a significant difference was found, which was statistically significant ($p<0.05$) (Table 1). Similar results were found in another study, but in which DM patients were not compared with cases of DN [15]. Similarly, patients with diabetes mellitus and DN showed a rise in the mean PPBS level above normal, which was statistically significant. Similar results were found in another study [16].and when both groups were compared, the patients with DN showed significantly higher values than DM patients ($p<0.05$) (Table 1).

In the present study, when a comparison was done between the groups, patients with diabetic nephropathy showed a significant rise in mean serum creatinine (mg/dl), serum urea (mg/dl), urine albumin creatinine ratio (mg/gm), and serum cystatin C values (ng/ml), which was statistically significant ($p<0.05$) (Table 2). In a previous study, it was mentioned that there was a rise in serum cystatin C levels in patients with diabetic nephropathy. The results support the present study [17]. In our study, a positive correlation was found between the levels of urine albumin creatinine ratio and serum cystatin C in patients with DN but not in those with diabetes mellitus, which indicates that serum cystatin C is a key marker for early detection of diabetic nephropathy (Table 3). Therefore, it is essential to have an early indicator of renal impairment in individuals who do not exhibit DN. Even though the serum cystatin C serves as an early indicator of DN, it has shown a positive correlation with the urine albumin creatinine ratio as renal function deteriorates. Early detection of DN would be crucial and could significantly decrease the rate of morbidity and mortality.

Conclusion

The findings of the present study suggested that patients of diabetes mellitus and diabetic nephropathy showed higher levels of blood glucose, serum urea, creatinine, serum cystatin C and urine albumin creatinine ratio. However, patients of DN showed a positive correlation between serum cystatin C and urine albumin creatinine ratio, but the same was not found in diabetic group which indicates that serum cystatin C serves as an early indicator of DN as it has shown a positive correlation with urine albumin creatinine ratio as renal function deteriorates. Early detection of DN would be crucial and could significantly decrease the rate of morbidity and mortality.

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