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Original Research Article

A Study on Renal Function Tests and its Correlation with Blood Glucose (FBS and PPBS) in Newly Diagnosed Type-2 Diabetes Mellitus

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Abstract:

Background and Objectives: Diabetes mellitus is a metabolic disorder characterized by increased blood sugar levels. It is of two types. Type two is very common, due to deficiency in secretion of insulin. That eventually affects derangement of carbohydrate, protein and lipid metabolism. On long standing, this metabolic derangement will affect vital organs like liver, kidney, brain etc. To study correlation analysis that determine strength and direction of relationship between indicator of DM (FBS and PPBS) and RFT (serum urea and serum creatinine) in Indian population.

Methods: A retrospective study design was done in government hospital, Rajkot, Gujarat, India (study population).Total 1,45,369 patients in period of April 2023 to April 2024 included in this study .Data sources from the laboratory tests. The patients who were tested for RFT (serum urea and serum creatinine) and DM (Plasma FBS, Plasma PPBS) were included in this study.

Results: A total of 1,45,369 cases were studied from April 2023 to April 2024 (1 year) of which 64% of males and 36% were females. Based on statically significant variables, multiple binary logistic using stepwise regression analysis was performed to determine that direct association of renal function test with diabetes mellitus.

Conclusions: Long standing diabetes can affect multisystem like neuropathy, nephropathy. Therefore, regular monitoring of RFT is essential in diabetic patients.

Keywords: Diabetes Mellitus, Renal Function Test, Fasting Blood Sugar, Post Prandial Blood Sugar.

Introduction

Long standing diabetes mellitus that affect several organs including the kidneys. It is a major public health problem and the leading cause of kidney failure worldwide. Early management of diabetes with strict control of blood glucose levels reduce microalbuminuria and progression of diabetic nephropathy [1].

The chronic hyperglycemias associated with this condition causes micro/macrovascular damage to the kidney [2].About 20-40 percent of those with type 2 diabetes eventually will suffer from kidney disease [3].In RFT(serum urea and serum creatinine) is tested. Renal function test plays crucial role in assessing kidney health, especially in individual with diabetes mellitus [4].

According to above analysis parameter hypothesis on serum creatinine and serum urea level is higher in diabetic patients compared to non-diabetic patients. General correlation found in diabetics in renal function test abnormalities. Longitudinal impact on serum creatinine and serum urea level is found between severity of renal function and duration of diabetics. Predictive factors like males, old age, comorbid condition like hypertention, cardiovascular diseases are more prone to diabetic nephropathy.

Early intervention in diabetics' management like medication, life style changes, diet changes, yoga in diabetics can lessen severity of diabetics' nephropathy.

Materials and Methods

A retrospective study of 1,45,369 cases over period of April 2023 to April 2024 clinical biochemistry laboratory, P.D.U.Medical college, was conducted in Rajkot city of Gujarat. Serum samples were to estimate RFT and blood sugar. In RFT, we analyses serum creatinine and serum urea and in DM profile FBS, PPBS.

Inclusion Criteria: Patients who was tested for FBS and RFT. Patients who was tested for PPBS and RFT.

Exclusion Criteria: Patients who was undergone for DM profile but not gone for RFT excluded from study or vice versa. Plasma FBS and PPBS taken in fluoride vaccutte, done in Abbott architect ci4000systems.Serum creatinine, urea done in plain vaccutte in Abbott architect ci4000 systems.

Plasma FBS and PPBS coefficient of variation is around 6-8 in April 2023 to April 2024. Serum creatinine coefficient variation is 4-7. Serum urea coefficient variation is 7-9.The method used for analysis is spectrophotometry.

Statistical Analysis: Age and sex distribution done in MS excel sheet. Continuous variable as mean ±SD, range and median. Discrete variables are summarized in terms of frequencies and percentages. Patients' correlation coefficient was used to analyses relation between diabetes parameters (glucose fasting and glucose post Prandial) with renal function parameter serum creatinine and serum urea. For association of diabetic group and control group with RFT chi-square test was used.

Results

A total of 1,45,369 cases were studied from April 2023 to April 2024 (1 year) of which 64% of males and 36% were females age group distribution.(Table 1) Age and diabetics –non diabetics distribution is in(table 2 and table 3) respectively. Among them who were tested for RFT, serum creatinine normal 34% and abnormal 66% and serum urea normal 41% and serum creatinine 59% (Table 4) .diabetes results (normal ,impaired, elevated) wise distribution is in (Table 5).

Among them who were tested for DM, fasting blood glucose. Positive correlation of glucose fasting was observed with serum creatinine level (r=0.1208, p=<0.0001) and serum urea (r=0.1178, p<0.0001) (table 6). Postprandial blood glucose also showed a positive correlation with serum creatinine level (r=0.1140, p=<0.0001) and serum urea (r=0.1178, p<0.0001) (Table 7).

Based on statically significant variables, multiple binary logistic using stepwise regression analysis was performed to determine that association of renal function test with diabetes mellitus.

Table 1: Gender wise distribution

Gender	Frequency	Percentage
Male	94239	64%
Female	51130	36%

Table 2: Age- wise distribution

Age	Frequency	Percentage
18-30	21036	15%
31-40	36544	25%
41-55	45231	31%
>55	42558	29%

Table 3: Group distribution according to blood sugar level

Group distribution	Fasting blood sugar	Post prandial blood sugar
Diabetics	50126	95243
Non diabetics	95243	50126

Table 4: RFT parameters wise distribution

Parameters	Frequency	Percentage
Serum urea-abnormal	85638	59%
Normal	59731	41%
Serum creatinine-abnormal	96530	66%
Normal	48839	34%

Table 5: Diabetes parameters wise distribution

Parameters	Frequency	Percentage
Glucose fasting-normal	33445	23%
Impaired	46320	31%
Elevated	65604	45%
Glucose postprandial-normal	29654	22%
Impaired	47215	32%
elevated	68500	47%

Table 6: correlation of Fasting blood glucose with abnormal RFTs

RFT	Correlation coefficient(r)	p-value
Serum creatinine	0.1208	<0.0001
Serum urea	0.1178	<0.0001

Table 7: correlation of postprandial blood glucose with abnormal RFTs

RFT	**Correlation coefficient(r)**	**p-value**
Serum creatinine	0.1140	<0.0001
Serum urea	0.1178	<0.0001

Discussion

Correlation of renal function test are crucial for monitoring kidney health, especially in patients with diabetes mellitus, as diabetes is a leading cause of chronic kidney disease. The primary test include serum creatinine-elevated levels can indicate impaired kidney function. Elevated urea levels may suggest reduced kidney filtration capacity. Correlation of diabetes prevalence (20-40%) and pathophysiology relate with kidney diseases [1]. Comparative studies shows type two diabetes and kidney diseases relate internally.

Type 2 diabetes management often requires a multifaceted approach addressing obesity, hypertension and dyslipidemia. Meta-analysis of several randomized controlled trials (RCTs) have confirmed that intervention aiming that reducing blood glucose levels and managing co-morbid condition like hypertention, obesity, and dyslipidemia are effective in preserving renal function tests in diabetics [2]. The pathophysiological mechanisms like a) hyperglycemia induced damage-glomerular hyper filtration-early in diabetes, the kidneys may filter blood at a higher rate, which can lead to damage over time. b) Advanced Glycation End-products (AGEs)-high blood sugar levels cause proteins and lipids to become glycated, forming AGEs. This can accumulate and fibrosis in kidney tissues. c) Diabetes often coexists with hypertension, which exacerbates kidney damage by increasing the pressure in glomeruli, leading to further injury. Proteinuria—damage to glomerular filtration barrier due to hyperglycemia and hypertention allows proteins such as albumin to leak into the urine, a condition known as proteinuria or albuminuria.

Persistent proteinuria is a marker of kidney damage, d) Protein kinase C activation-chronic hyperglycemia leads to increased production of DAG, which in turn activates PKC, particularly β and δ is enzymes. e) Vascular complications like endothelial dysfunctions, increase vascular permeability, inflammation-PKC activates promotes expression of cytokines and adhesion molecules, exacerbating vascular inflammation and atherosclerosis [3-5]. PKC activation in renal cells contributes to glomerular hyper filtration, mesangial expantion and increased production of extracellular metrix proteins, leading to glomerulosclerosis and kidney damage. Therapeutic implications like PKC inhibitors e.g. ruboxistaurin has shown promise in reducing complications like diabetic retinopathy and nephropathy in clinical trials. f) Renin-Angiotensin-Aldosterone System (RAAS) Activation-Renin converts Angiotensinogen to Angiotensin I is converted to Angiotensin II by Angiotensin converting enzymes. Angiotensin II is a potent vasoconstrictor and stimulates aldosterone secretion. Aldosterone promotes sodium and water reabsorption in kidneys [3-5]. However, due to hyperglycemia damages blood vessels. High blood glucose leads to hypertension and renal damage. RAAS inhibitors communally used in diabetics to control blood pressure and protect renal functions [3]. In summary, the activation of the RAAS has significant amplifications for renal function, especially in a context of diabetes mellitus.

Chronic high blood glucose levels in diabetes lead to increased production of angiotensin II, which contribute to progression of diabetic nephropathy. ACE inhibitors like enalpril, lisinopril and angiotensin II receptor blockers e.g. losartan, valsartan for managing hypertention and slowing the progression of diabetic nephropathy [6-7]. Inflammation and oxidative Stress-chronic hyperglycemia induces oxidative stress and inflammation, contributing to structural and functional changes in kidneys. Tubulointer stastical damage, changes in renal hemodynamics-glomerular hyper filtration, mesangial cell expansion, inflammation and fibrosis, proteinuria is associated with diabetic nephropathy. Strength of our studies is large sample size, longitudinal data, diverse populations, advanced diagnostic tools.

Limitations on our studies is variability in definitions and measurements, heterogeneity of study populations, confounding factors, short follow-up periods, limitations external validity, publication Bias, evolving treatment standards, resource and technological limitations. Recognizing these limitations helps in critically apprizing the evidence and guiding future research to address existing gaps. Among all the 1,45,369 cases high level of serum creatinine suggest impaired kidney functions.

As kidney may struggle to adequately filter and excrete waste products. Increase urea level can also signify impaired kidney function. In diabetics high BUN levels may indicate reduced filtration capacity. Long-standing diabetes due to microvascular changes renal glomerular membrane changes. That affects renal function tests.

Conclusion

It can be concluded from the study that serum creatinine, serum urea were significantly elevated in patients with diabetes-Type 2 as compared to healthy populations. Multipleregretion analysis of blood glucose and renal function showed significant differences in respect to serum creatinine level. Diabetes being microvascular condition, renal Glomerular and tubular function damages as disease advances, hence regular screening and close monitoring of renal function in diabetic patients are crucial for timely intervention and management to prevent or delay the progression of diabetic kidney disease and its associated complications.

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