



ISSN Print: 2617-4693
 ISSN Online: 2617-4707
 IJABR 2019; 3(2): 01-04
 www.biochemjournal.com
 Received: 10-10-2019
 Accepted: 30-10-2019

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Estimation of serum creatinine, blood urea nitrogen and urine analysis in patients with diabetes to assess the renal impairments

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Abstract

Introduction: Serum urea and creatinine are most widely accepted parameters to assess renal impairment (CKD) in diabetes.

Aim: To assess the serum Blood urea nitrogen, creatinine and protein levels in diabetes mellitus subjects to identify the renal impairments.

Materials and Methods: This cross-sectional study was done on 40 subjects involving 15 Type 1, 15 Type 2 diabetic and 10 healthy controls. After collection of blood samples, urea creatinine, blood sugar and proteins were analyzed by enzymatic and calorimetric method.

Results: In the present study, a total of n=40 diabetic subjects were included, out of which n=20 were male and n=20 were female subjects. The male to female ratio was 1:1. The age of the subjects ranged from 35 - 55 years and the mean age was 50.92 years. The age of the healthy controls ranged from 45 - 52 years and the mean age was 47.72 years. Mean value of Blood glucose (FBS) levels in type 2 diabetes and type were found to be (145.13±10.84; 152.2±9.03) whereas in control group was observed to be 110±7.91). The mean (±SD) value of creatinine in type 2 diabetes group were found to be (2.53±10.84), whereas in type 1 diabetes group were found to be (2.99±0.67). The mean value of creatinine in control group was observed to be 0.80±0.08. Thus, the mean blood urea and serum creatinine levels were statistically significantly ($p \leq 0.05$). Blood urea nitrogen in both the diabetic patients compared to healthy controls. (In type 2, 49.66±6.91; Type 1, 48.66±6.73 and in healthy controls was observed to be 10.91±1.68). Urine pH also slightly high in diabetic patients compared to healthy controls. Mean value of proteins in type 1 diabetes found to be 143.13±21.53; whereas in type 2 142.53±28.80. In healthy control subjects mean protein value was observed to be 114.2±3.04.

Conclusion: Strong relationship of blood urea and serum creatinine levels was found with blood sugar levels. Blood urea and serum creatinine levels along with blood glucose levels would be helpful to monitor the diabetes patients to assess renal function.

Keywords: Blood urean nitrogen, creatinine, diabetes, proteins

Introduction

Chronic Kidney Disease (CKD) is a progressive reduction in renal function [1]. It is a condition where the kidneys lose their normal function, especially excretory and regulatory functions which can be due to infections, autoimmune diseases, diabetes, hypertension, cancer and toxic chemicals [2]. CKD is heading towards becoming a major health problem [3] and is rapidly assuming epidemic proportions globally [4]. India has highest number of diabetics in the world having a prevalence of 3.8% in rural and 11.8% in urban adults [3]. It is associated with adverse outcomes in all stages of CKD [5]. It has been estimated that approximately 25- 40% of diabetic and hypertensive patients usually develop CKD (Nephropathy) [3]. Studies conducted on renal patients revealed that up to 90% were found to have oral symptoms of uremia like ammonia like taste and smell, stomatitis, gingivitis, decreased salivary flow, xerostomia and parotitis [2]. The objectives of early diagnosis is identification of asymptomatic disease at that time when intervention has a reasonable potential of a positive impact on outcome [3].

Diabetes is also one of the major causes of kidney failure [6]. Diabetic nephropathy (DN) is the most common clinical condition of the diabetic patients with progressive deterioration of renal function and structure during their life time [7, 8]. DN affects 30% of all diabetics and it is the major leading cause of end stage renal disease (ESRD) in many countries [9-12]. DN is characterized by abnormal levels (more than 300 mg/day) of albumin in the urine, referred as macro albuminuria [13, 14] and abnormal renal function as represented by an abnormality in

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blood urea and serum creatinine. In DN, bio-markers viz. blood urea and serum creatinine are known to be raised with hyperglycemia in uncontrolled diabetics, usually correlating with kidney damage severity. Measurements of blood urea and serum creatinine are easily available tests which can assist in detection and prevention of diabetic kidney diseases at an early stage thereby, limit the progression to end stage renal disease [15, 16].

Biochemical markers play an important role in accurate diagnosis and in assessing risk and adopting therapy to improve clinical outcome. Instead of urine analysis which is relatively discomforting for patient, serum analysis of renal function markers like urea, creatinine, uric acid and electrolytes are used routinely [17]. Blood tests for Blood Urea Nitrogen (BUN) [18] which is a major nitrogenous end product of protein and amino acid catabolism [17] and creatinine [18] which is a breakdown product of creatinine phosphate in muscle [17] are excreted by kidneys. BUN is an indirect and rough measurement of renal function that measures the amount of urea nitrogen in blood and is directly related to excretory function of kidney. Creatinine tests diagnose impaired renal function and measure the amount of creatinine phosphate in blood. Urea and creatinine are good indicators of a normal functioning kidney and increase in the serum are indications of kidney dysfunction. BUN and serum creatinine are widely accepted and most commonest parameters to assess renal functions [19].

The aim of this study was to quantitatively estimate the amount of urea, creatinine, protein analysis and glucose present in the serum of type 1 and type 2 diabetes patients.

Materials and Methods

A cross-sectional study was conducted in Government Medical College and Hospital, Siddipet, Telangana, India for 6 months duration on 40 subjects of either sex aged between 30 to 70 years.

Subjects included in the study were divided into three groups

- Group I: 15 subjects with Type 2 Diabetes
- Group II: 15 subjects with diabetes (Type 1)
- Group III: 10 subjects healthy adults as controls

Inclusion criteria

Subjects with diagnosed type II diabetes mellitus and Type I diabetes were included in the study.

Exclusion Criteria

Pregnant women, subjects with recent history of hospitalization, infusions and trauma, subjects known to have any salivary gland or oral diseases, subjects who are critically ill or unconscious, subjects not willing to participate and approve the informed consent were excluded from the study.

Blood Sample Collection and Analysis

Blood samples of all these subjects were collected to study the parameters such as blood urea and serum creatinine with relation to blood sugar level (BSL). Under aseptic conditions 2ml of the patient's intra-venous blood was collected for measuring serum creatinine, glucose and urea. For biochemical investigations serum was separated by centrifugation at 4000 rpm for 10 minutes and kept at -4 °C

until analysis. Blood sugar levels were estimated by glucose oxidase and peroxidase (GOD-POD) end point assay method [20], blood urea was estimated by enzymatic urease method [21], while serum creatinine was estimated by alkaline Jaffe's Picrate method [22]. The normal ranges for blood sugar level (BSL), fasting is 70 – 110 mg/dl, post prandial (PP) is <140 mg/dl. Similarly, the normal range for blood urea is 15-40 mg/dl, and 0.6 - 1.4 mg/dl and 0.5 - 1.2 mg/dl for serum creatinine for males / females respectively. Post prandial (PP) is (FBG), post prandial blood glucose (PPBG), blood urea and serum creatinine parameters were analyzed using Human reagent kits and with the help of semi auto analyser (Humalyser 3500, Germany).

Statistical analysis

The data collected was analyzed using Excel 2003. The statistical data was analyzed by student's t-test to compare the significance between diabetic and non-diabetic control groups. The data was expressed as mean and standard deviation (mean±SD). p value of less than 0.05 ($P \leq 0.05$) was considered as statistically significant.

Results and Discussion

In the present study, a total of n=40 diabetic subjects were included, out of which n=20 were male and n=20 were female subjects. The male to female ratio was 1:1. The age of the subjects ranged from 35 - 55 years and the mean age was 50.92 years. The age of the healthy controls ranged from 45 – 52 years and the mean age was 47.72 years.

In the present study mean value of Blood glucose (FBS) levels in type 2 diabetes and type were found to be (145.13±10.84; 152.2±9.03) whereas in control group was observed to be 110±7.91).

High blood sugar levels damage millions of nephrons resulting in inability of kidneys to maintain fluid and electrolyte homeostasis. Creatinine is filtered by glomerulus and thus, serum creatinine level is considered as an indirect measure of glomerular filtration. Diminishing of glomerular filtration rate results in rise of plasma concentrations of serum creatinine and urea.

Patients with type 1 and type 2 diabetes found high levels of renal markers such as creatinine, blood urea nitrogen and protein levels compared healthy controls. The mean (±SD) value of creatinine in type 2 diabetes group were found to be (2.53±10.84), whereas in type 1 diabetes group were found to be (2.99±0.67). The mean value of creatinine in control group was observed to be 0.80±0.08. Thus, the mean blood urea and serum creatinine levels were significantly ($p \leq 0.05$) higher in the diabetic subjects over non-diabetic control group. Various previous studies showed that the blood urea levels increased proportionally to the increase in serum creatinine [23, 24]. The results of our study in agreement with earlier studies which showed that raised serum creatinine and blood urea levels in diabetic patients may indicate a pre-renal problem and it reduce the normal kidney function [25, 26].

Table 1: Levels of renal markers and Glucose in Healthy individuals (N=10)

| Type of Parameter | Mean±SD |
|---------------------------|------------|
| Creatinine | 0.80±0.08 |
| Blood urea Nitrogen (BUN) | 10.91±1.68 |
| pH | 6.74±0.49 |
| Proteins | 114.2±3.04 |
| Glucose | 110±7.91 |

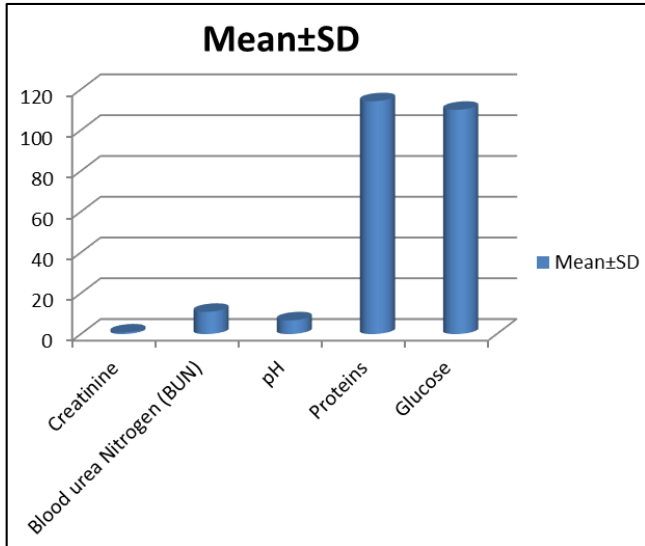


Fig 1: Table 1. Levels f renal markers and Glucose in Healthy individuals (N=10)

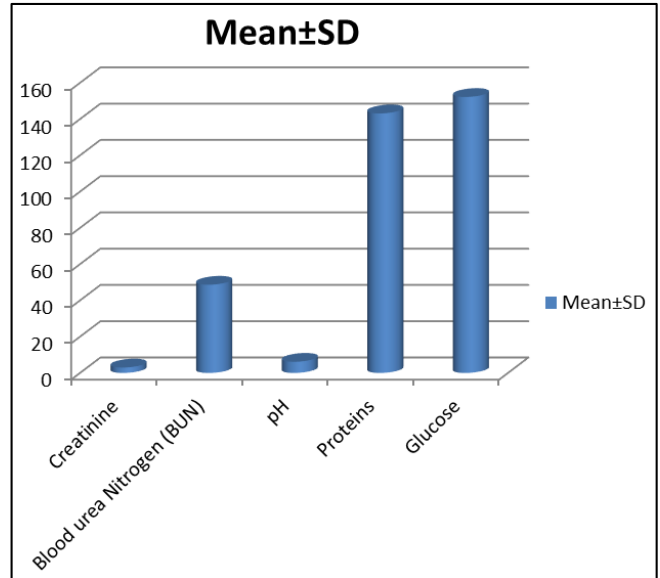


Fig 3: Levels f renal markers and Glucose in Type 1 Diabetes Mellitus (n=15)

Table 1: Levels f renal markers and Glucose in Type 2 Diabetes Mellitus (n=15)

| Type of Parameter | Mean±SD |
|---------------------------|--------------|
| Creatinine | 2.53±10.84 |
| Blood urea Nitrogen (BUN) | 49.66±6.91 |
| pH | 6.15±0.77 |
| Proteins | 142.53±28.80 |
| Glucose | 145.13±10.84 |

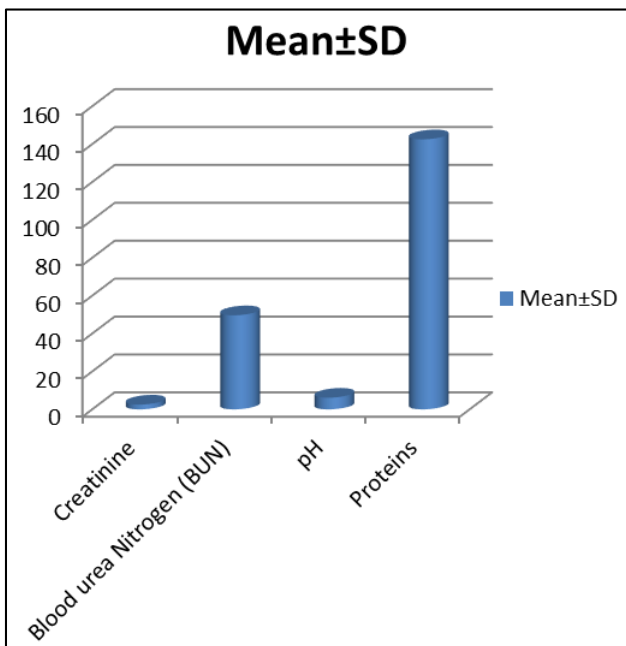


Fig 2: Levels f renal markers and Glucose in Type 2 Diabetes Mellitus (n=15)

Table 2: Levels f renal markers and Glucose in Type 1 Diabetes Mellitus (n=15)

| Type of Parameter | Mean±SD |
|---------------------------|--------------|
| Creatinine | 2.99±0.67 |
| Blood urea Nitrogen (BUN) | 48.66±6.73 |
| pH | 6.16±0.61 |
| Proteins | 143.13±21.53 |
| Glucose | 152.2±9.03 |

In the present study we found increased mean value of Blood urea nitrogen in both the diabetic patients compared to healthy controls. (In type 2, 49.66±6.91; Type 1, 48.66±6.73 and in healthy controls was observed to be 10.91±1.68). Urine pH also slightly high in diabetic patients compared to healthy controls. Mean value of proteins in type 1 diabetes found to be 143.13±21.53; whereas in type 2 142.53±28.80. In healthy control subjects mean protein value was observed to be 114.2±3.04.

In the present study, the mean value of blood urea and serum creatinine when compared to mean value of the blood sugar, the p value was found to be statistically significant ($p \leq 0.05$). These findings show that there is a relationship of increased blood sugar level with blood urea level indicating that as there is persistent increase in blood sugar level and increase in blood urea levels. Our study results shows that poorly controlled blood sugar levels would cause increase in the blood urea levels and it leads to the development of diabetic nephropathy. Our study accordance with the earlier study reports that hyperglycemia is one of the major causes of progressive renal damage [27, 28]. In our study, we found that increase of blood urea level with the increment of blood sugar level clearly indicates that long standing high blood sugar levels causes damage to the kidney it leads to the development chronic kidney diseases. In previous studies found that increase blood urea and serum creatinine in diabetic rats indicates progressive renal damage [27]. Serum levels of urea and creatinine can be used as prognostic markers and predictors of renal damage in diabetic patients. Effective control of blood sugar levels can stop progression to diabetic nephropathy and thus remarkably reduce the morbidity and mortality associated with this metabolic disease.

Conclusion

The present study revealed that poor glycemic status will lead to the progress of impaired renal function. We conclude that blood urea and serum creatinine levels are simple tests helpful in poorly controlled diabetes to assess the renal function.

Acknowledgement

The author thankful to Department of Biochemistry, Government Medical College & Hospital, Siddipet for providing all the facilities to carry out this research work.

Conflict of interest: None

Financial Support: Nil

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