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Prospective study on early morning urine spot microalbumin in type 2 diabetic subjects on oral anti-diabetic medication

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Abstract
Introduction: Diabetes is a common endocrine disorder, widely prevalent in most of the developing and developed nations. Diabetes Mellitus is characterised by increased blood glucose levels (hyperglycemia), is a silent killer and it kills 10 years before our time as per the study conducted by Oxford University. Uncontrolled Diabetes leads to development of macrovascular and microvascular complications. Diabetic nephropathy is the leading microvascular complication affecting the diabetic subjects, leading to end stage renal disease.
Objectives of the study: To evaluate early morning spot urine microalbumin levels in subjects with type 2 diabetes and to evaluate renal function tests like blood urea and serum creatinine levels in subjects with type 2 diabetes.
Materials and Methods: Early morning mid-stream urine sample was collected and used for urine microalbumin estimation and the same sample was used for urine microscopy to exclude patients with urinary tract infection. Fasting overnight blood sample was collected into EDTA and fluoride tubes to measure HbA1c and Fasting Blood Glucose respectively. HbA1c was measured by HPLC method.
Statistical Analysis: The data was expressed in terms of mean and standard deviation.
Results: A total of 120 subjects were enrolled in the study, 60 type 2 diabetic subjects and 60 healthy controls. Out of 60 cases, 34 were males and 26 were females. Among 60 controls 32 were males and 28 were females. The mean and SD of fasting blood glucose, post-prandial blood glucose, glycated hemoglobin levels were elevated in type 2 diabetic subjects as compared to healthy controls. All the type 2 diabetes subjects were evaluated for urine spot microalbumin, which revealed that the prevalence of microalbuminuria was 36.6%.
Conclusion: Our study recommends that since 2 DM patients have a considerable risk factor for developing renal impairment, they should be regularly monitored for more sensitive biomarkers of nephropathy such as microalbuminuria and HbA1c levels to facilitate early detection of diabetes-induced nephropathy. Many studies have confirmed that an angiotensin-converting enzyme inhibitor (ACEI) or angiotensin receptor blocker (ARB) can retard the progression of albumin excretion.

Keywords: diabetes, microalbumin, renal function tests, urea and serum creatinine

Introduction

Diabetes is a common endocrine disorder, widely prevalent in most of the developing and developed nations. Diabetes Mellitus is characterised by increased blood glucose levels (hyperglycemia), is a silent killer and it kills 10 years before our time as per the study conducted by Oxford University. As per International Diabetes Federation, there are about 382 million people worldwide living with diabetes, and India ranks among top three countries [1].

Diabetes is mainly classified as Type 1 diabetes and type 2 diabetes. Type 1 diabetes is due to absolute deficiency of insulin and in type 2 diabetes there is decreased peripheral response of the tissues to the action of insulin due to insulin resistance, and initially there is relative deficiency of insulin, and later due to chronic hyperglycemia it can lead to destruction of beta cells of pancreas resulting in absolute deficiency of insulin. In both the conditions, the blood glucose levels are increased (hyperglycemia) [2]. Specially in type 2 diabetes is more common in genetically pre-disposed individuals which runs in families, the combination of less physical activity and excess caloric intake can lead to obesity which in turn, leads to a state of decreased insulin sensitivity (insulin resistance) [3]. Further, decrease in β-cell mass and abnormalities of β-cell function can both be demonstrated in patients with type 2 diabetes and individuals at increased risk for diabetes [4]. Most type 2 diabetics are often obese [5].

Uncontrolled Diabetes leads to development of macrovascular and microvascular complications: the macrovascular complications include cerebrovascular accidents, coronary artery disease, peripheral vascular disease and the microvascular complications include nephropathy, retinopathy and neuropathy [6].

Diabetic nephropathy is the leading microvascular complication affecting the diabetic subjects, leading to end stage renal disease. It affects approximately 30% of all diabetic population who have uncontrolled diabetes. Assessment of a renal function tests in these patients on regular basis is very important for two reasons.

One is to diagnose impaired renal function, and the other is to detect the presence of a progressive loss of renal function. Diabetic nephropathy is characterized by macroalbuminuria i.e excretion of more than 300 mg of protein (especially albumin) per 24 hours of urine and abnormal renal function tests characterized by elevation of blood urea and serum creatinine. Clinically, diabetic nephropathy is characterized by decline in glomerular function rate (GFR), proteinuria, hypertension, and high risk of cardiovascular morbidity and

mortality. Assessment and further prevention of diabetic kidney disease at an early stage and can limit the progression to end stage renal disease (ESRD) [7, 8].

Early renal damage cannot be picked by rise in the serum creatinine levels. Serum creatinine elevated are elevated when there is 50% of the renal damage. The initial decreased in the GFR levels (GFR blind area) can be picked up early by measuring urine microalbumin levels. Microalbuminuria is defined as the excretion of urine albumin levels in the range of 30-300 mg/day. Annual screening of microalbuminuria is recommended for all diabetic patients. Many studies have confirmed that an angiotensin-converting enzyme inhibitor (ACEI) or angiotensin receptor blocker (ARB) can retard the progression of albumin excretion. The Kidney Disease Outcomes Quality Initiative guidelines state that ACR measurement in a first-morning spot urine collection is adequate and a timed urine collection is not necessary [9, 10].

Objectives of the study

The objectives of our study include,

1. To evaluate early morning spot urine microalbumin levels in subjects with type 2 diabetes.
2. To evaluate renal function tests like blood urea and serum creatinine levels in subjects with type 2 diabetes.

Materials and Methods

Source of data and Study design

A prospective study was conducted at CM Medical College and Research, Bhilai, Durg from December 2018-June 2019.

Inclusion Criteria

We included diagnosed cases of type 2 diabetic subjects who are on oral-antidiabetic medication.

Exclusion Criteria

Baseline elevated urea, creatinine levels, type 1 diabetes, urinary tract infections, end-stage renal disease, underlying renal disease, pregnancy, chronic infections, hypothyroidism and type 2 diabetic subjects on insulin therapy.

Sample collection and biochemical analysis

Early morning mid-stream urine sample was collected and used for urine microalbumin estimation and the same sample was used for urine microscopy to exclude patients with urinary tract infection. Fasting overnight blood sample was collected into EDTA and fluoride tubes to measure HbA1c and Fasting Blood Glucose respectively. HbA1c was measured by HPLC method.

Statistical Analysis

The data was expressed in terms of mean and standard deviation. Relationship between variables was assessed by Karl Pearson's coefficient of correlation. P-value of 0.05 or less was considered as statistically significant.

Results

A total of 120 subjects were enrolled in the study, 60 type 2 diabetic subjects and 60 healthy controls. Out of 60 cases, 34 were males and 26 were females. Among 60 controls 32 were males and 28 were females. The mean and SD of age (years) in cases was 52±9.89 as compared to controls which was 42.6±12.9. The mean and SD of fasting blood glucose, post-prandial blood glucose, glycated hemoglobin levels were elevated in type 2 diabetic subjects as compared to healthy controls (table 1). All the type 2 diabetes subjects were evaluated for urine spot microalbumin, which revealed that the prevalence of microalbuminuria was 36.6% (table 2).

Table 1: Shows Gender, Age and HbA1c values in Non-Diabetic and Diabetic Subjects

	Controls (no 60)	Cases (no 60)
Males	32	34
Females	28	26
Age (in years)	44.5±11.9	52±9.89
Fasting Blood Glucose (mg/dL)	91.56±10.06	164.76± 23.81
Post Prandial Blood Glucose (mg/dL)	112.3± 21.34	201.45± 76.13
HbA1c (%)	5.2±0.4	8.14±1.92

Table 2: Distribution of type 2 diabetic subjects depending on urine spot albumin levels with normal blood urea and serum creatinine

Urine Spot Microalbumin (in mg/L)	No (Percentage)	Mean±SD (microalbumin in mg/L)
<30mg/L (Normoalbuminuria)	37 (61.6%)	8.46±5.32
30-300mg/L (Microalbuminuria)	22 (36.6%)	76.02±51.02
>300 mg/L (Macroalbuminuria)	1 (1.66%)	300.65±32.14

Discussion

In our study, we found the prevalence of 36.6 (27/60) and 1.66% (1/60) subject had macroalbuminuria. This prevalence is comparable with other clinic based studies. John *et al*., Gupta *et al*., and Yajnik *et al*., showed Micro-albuminuria prevalence of 19.7%, 26.6% and 23.0% in clinic based studies at Vellore, New Delhi and Pune respectively. Another clinic based study by Varghese *et al*., at Chennai showed Micro-albuminuria prevalence of 36.3%. Varghese *et al*., showed overt nephropathy prevalence of 2.2 % [11-13]. Since there is high prevalence of DM and its chronic complications, Diabetic nephropathy; it is important to detect renal involvement promptly as renal involvement is reversible at the initial stage, and progression can be controlled. Early detection reduces both mortality and treatment cost in those affected. This can be done through screening of DM patients for Micro-albuminuria as its the earliest clinical manifestation of renal disease. Since long-term hyperglycemia among diabetic patients can lead to permanent organ dysfunction including kidneys, regular monitoring of HbA1c levels and organ-specific biomarkers are essential.

Conclusion

Our study recommends that since 2 DM patients have a considerable risk factor for developing renal impairment, they should be regularly monitored for more sensitive biomarkers of nephropathy such as microalbuminuria and HbA1c levels to facilitate early detection of diabetes-induced nephropathy. Many studies have confirmed that an angiotensin-converting enzyme inhibitor (ACEI) or angiotensin receptor blocker (ARB) can retard the progression of albumin excretion.

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