



Original Research Article

Renal function impairment and HbA1c level in type 2 diabetes mellitus patients

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ABSTRACT

Introduction: Diabetic patients are prone to develop coronary heart disease, stroke and even microvascular complications like diabetic nephropathy, retinopathy and neuropathy. Chronic hyperglycemia is considered an important etiological factor leading to such complications. Diabetic nephropathy is one of the most common causes of chronic kidney disease (CKD) in India. For staging of CKD, estimation of the glomerular filtration rate (GFR) is necessary. One of the commonly used equations to estimate GFR (eGFR) is the equation from the Modification of Diet in Renal Disease (MDRD) study. This study was carried out to assess correlation between glycemic control of type 2 diabetic patients, assessed by HbA1c, with their renal impairment status, checked by eGFR.

Materials and Methods: 50 patients of type 2 Diabetes Mellitus (T2DM) and 50 non diabetic controls were enrolled for the study. Their fasting blood sugar (FBS), serum creatinine and HbA1c level were measured and eGFR were calculated using MDRD equation. HbA1c levels were compared with eGFR values.

Result: HbA1c levels were significantly correlated with eGFR in diabetic patients. But no significant correlation was found between these two parameters in non diabetic controls.

Conclusion: Renal function impairment due to diabetic nephropathy can be predicted by measuring HbA1c levels in diabetic patients and proper measures can be planned to delay significant renal damage.

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1. Introduction

Type 2 diabetes has shown increase in both the prevalence and incidence globally especially in societies with economic transition like industrialized countries and developing countries.¹ The number of people suffering from diabetes has risen significantly, from 108 million in 1980 to 422 million in 2014. 8.5% in 2014.² Along with urbanization, people have developed of unhealthy lifestyle and dietary habits, which are considered to be the most important factors for the development of diabetes.¹ If diabetic patients remain undiagnosed or inadequately treated, which is the usual case, develop many chronic complications leading to several disability and even death. Risk of coronary heart disease and stroke is significantly high in diabetics than in the general population and even microvascular

complications like diabetic nephropathy, retinopathy and neuropathy are also serious health problems which can deteriorate the quality of life and can lead to premature death.¹ Although the exact mechanism which is responsible for various cellular and organ dysfunction in DM is not clearly known, chronic hyperglycemia is considered an important etiological factor leading to complications.³ The Diabetes Control and Complications Trial (DCCT) also showed that by achieving glycemic control close to the nondiabetic level by intervention can significantly reduced all the microvascular and complications of diabetes in type 1 DM.⁴ For assessment of long-term glycemic control, estimation of glycated hemoglobin is the standard method. Consistently elevated plasma glucose leads to increase in nonenzymatic glycation of hemoglobin. As the average life span of red blood cell is 120 days, glycated hemoglobin gives idea about the glycemic control of previous 2–3

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months.³

Diabetic nephropathy is one of the most common causes of chronic kidney disease (CKD) in India.⁵ For staging of CKD, estimation of the glomerular filtration rate (GFR) is necessary. One of the commonly used equations to estimate GFR (eGFR) is equation from the Modification of Diet in Renal Disease (MDRD) study. This equation estimates GFR based on measured serum creatinine concentration, age, sex, and ethnic origin of an individual.⁶

2. Aims and Objective

This study was carried out to find association of glycemic control of type 2 diabetic patients with their renal impairment status, if any. HbA1c levels were estimated to know the glycemic control and they were compared with eGFR levels.

3. Materials and Methods

The study was carried out at Clinical Chemistry Laboratory of Biochemistry Department, S SG Hospital and Medical College, Baroda. Ethical Clearance was obtained from the Institutional Ethics Committee for Human Research. 50 patients of known cases of diabetes and 50 age and sex matched healthy individuals enrolled for the study after taking informed consent. They were divided into Group I -control group (n=50) consisted of age and sex matched persons coming to OPD for routine checkups or minor ailments and not having history of Diabetes Mellitus and Group II comprises known case of type -2 Diabetes Mellitus (n=50). Individuals who had recently (<3 months) received blood transfusion or donated blood, having active infections or pre-existing kidney disease and having haemoglobinopathies or bleeding disorder were excluded.

3.1. Study design

Informed consent of individuals included in the study was obtained for participation in study groups and for blood collection. Detailed medical history including personal history, present complaints and complication, past history, family history and treatment history was recorded.

Overnight fasting blood sample was collected in fluoride vacutainer (2 ml) for FBS, in EDTA vacutainer (2 ml) for HbA1c and in plain vacutainer (4 ml) for serum creatinine and other biochemical parameters. Serum or plasma separated within an hour and stored at 2-8° C temperature till analysis was done.

Estimation of serum creatinine was carried out by Modified Jaffe's Kinetic method, plasma glucose by glucose oxidase - peroxidase method and HbA1c by turbidimetric immunoassay method. All estimations were carried out on Miura-300, fully automated biochemistry analyzer.

For estimation of GFR, Modification of Diet in Renal Disease (MDRD) equation was used. As per MDRD equation,

$$eGFR \text{ (mL/min per } 1.73 \text{ m}^2\text{)} = 186 \times (\text{S.Creatinine})^{-1.154} \times (\text{Age in years})^{-0.203}$$

for female : multiply by 0.742

for African Americans: multiply by 1.21

3.2. Statistical analysis

Statistical analysis was carried out using MedCalc version 19.1 (free trial version) and Microsoft Excel 2010. Student's t-tests was used for comparisons. Value of $p < 0.05$ was taken as statistically significant and $p < 0.001$ as statistically highly significant for all analysis. To assess correlation between different parameters regression correlation analysis was carried out.

4. Results

The study population consists of 50 type 2 DM patients and 50 controls. Gender distribution and average age in both groups is shown in Table 1.

Table 1: Gender distribution and mean age

	Group I (Controls) n=50	Group II (T2DM) n=50
No. of Male	29	26
No. of Female	21	24
Age (Mean±SD)	42.3±7.4	42.9±5.6

shows comparison of FBS, HbA1c, S.creatinine and eGFR in type 2 DM patients and control group. Average HbA1c and FBS values were higher in Type 2 DM patients and difference was highly significant ($p < 0.001$). S.creatinine was significantly high in group II ($p < 0.05$) and eGFR values were on lower side. The difference in eGFR values of both groups was highly significant ($p < 0.001$).

Correlation of FBS and HbA1c with eGFR was calculated using regression analysis (Table 3). Only in Group II (T2DM) significant negative correlation was found between HbA1c and eGFR ($p < 0.001$). Graph 1 shows scatter plot for regression analysis between HbA1c and eGFR in Group II (T2DM).

5. Discussion

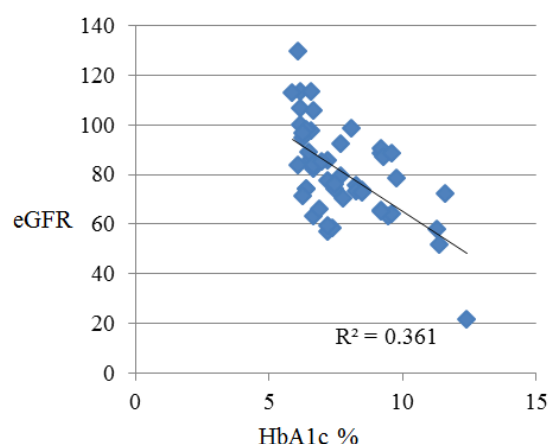
Diabetic nephropathy is one of the common complications in diabetic patients; around 20% to 30% of diabetic patients develop diabetic nephropathy. Chronic hyperglycemia is an important factor in development of nephropathy.⁷ In controls we found mean HbA1c level 5.59 ± 0.61 which was significantly lower than that of Type 2 DM patients which was 7.78 ± 1.63 . eGFR values, calculated using MDRD formula, were negatively related with HbA1c levels in Type 2 DM patients. Various studies have

Table 2: Comparison of FBS, HbA1c, S. Creatinine and eGFR in both groups.

	Group I (Controls) n=50		Group II (T2DM) n=50		p value
	Mean	SD	Mean	SD	
FBS (mg/dl)	99.16	14.20	125.34	26.82	<0.001
HbA1c (%)	5.59	0.61	7.78	1.63	<0.001
S. Creatinine (mg/dl)	0.84	0.20	0.99	0.25	<0.05
eGFR (mL/min/1.73 m ²)	102.07	34.84	80.77	19.00	<0.001

Table 3: Regression analysis showing correlation between (i) FBS and eGFR and (ii) HbA1c and eGFR in both groups.

Group	Parameter	eGFR (mL/min/1.73 m ²)		p value
		r	r ²	
Group I (Controls)	FBS (mg/dl)	-0.1025	0.0105	0.479
	HbA1c (%)	-0.1714	0.02938	0.234
Group II (T2DM)	FBS (mg/dl)	-0.0204	0.00042	0.888
	HbA1c (%)	-0.601	0.36119	< 0.001



Graph 1: Regression analysis between HbA1c and eGFR in Group II (T2DM).

suggested increased risk of neuropathy, retinopathy and cardiovascular diseases with increase in HbA1c level in diabetic patients.^{8–10} In a collaborative meta-analysis of 102 prospective studies, Emerging Risk Factors Collaboration concluded in diabetic patients risk of vascular diseases is related with their FBS is moderately, and relationship is non linear.¹¹ In our study we found no significant relationship of FBS with e GFR level.

6. Conclusion

Early identification of imminent complications like nephropathy in diabetic patients can definitely help in decreasing morbidity. HbA1c level in diabetic patients can significantly predict compromised renal function in diabetic patient, before alteration in serum creatinine levels. Regular monitoring of HbA1c level and changing treatment strategy based upon it, can delay the development of diabetic nephropathy.

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7. Conflict of interest

None.

8. Source of funding

None.

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