RESEARCH ARTICLE

Pattern of HbA1c and eGFR Levels among Diabetic and Non-diabetic Patients in a Specialized Hospital

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Abstract :

Background: The global prevalence of chronic kidney disease in diabetic patients is rapidly accelerating due to an increasing number of people living with type 2 diabetes. It has become a significant global problem, increasing human and financial pressures on already overburdened healthcare systems. **Materials and method:** This cross sectional study was done in the department of Biochemistry and Molecular Biology, BIRDEM Academy from July 2017 to June 2018. Data about socio- demographics and biochemical parameters (fasting serum glucose, HbA1c, serum creatinine and estimated GFR, were measured in 3 groups-healthy individuals, diabetic patients without CKD and diabetic patientswith CKD (63 subjects in each group) by appropriate method. The data was then analyzed and expressed in tables and charts with SPSS version 22. **Results:** Male and female were 62.4% and 37.6% respectively. Mean HbA1c in healthy people and diabetic patient without CKD and diabetic patient with CKD were 4.70±0.47, 7.81±1.83 and 9.00±2.51% respectively. HbA1c was significantly higher in diabetic patient with CKD than other two groups ($p<0.001$).We found a negative correlation of HbA1C with eGFR($p<0.001$). **Conclusion:** This study concluded that increased HbA1c level is associated with development of CKD in type 2 diabetic patients.

Keywords: Diabetes Mellitus, Chronic Kidney Disease, HbA1c, eGFR

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Introduction:

The incidence of diabetes is increasing worldwide, with subsequent increase in the incidence of diabetic nephropathy[1]. The International Diabetes Federation (IDF) has estimated that 463 million adults live with diabetes worldwide in 2019, with a projected increase to 700 million by 2045. Seventy-nine per cent of those with diabetes live in low- and middle income countries. In Bangladesh, there were 8.4 million adults living with diabetes in 2019, and projected to almost double (15.0 million) within the next twenty five years[2]. Diabetic nephropathy is the most common

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cause of end-stage renal disease worldwide and accounts for a significant increase in mortality and morbidity in patients with diabetes3.Patients with diabetic nephropathy are diagnosed based on elevated urinary albumin excretion (UAE) and / or reduced estimated glomerular filtration rate (eGFR), and this issue is becoming a social burden[4,5]. The factors contributing to the development of kidney disease in diabetic patients can be classified as modifiable and non-modifiable. Modifiable factors include hyperglycemia and the mechanisms by which hyperglycemia invokes functional and structural changes on the kidney[6]. Poor control of diabetes mellitus, characterized by hyperglycemia, will progressively lead to a decrease in the Glomerular Filtration Rate (GFR) and the destruction of the glomeruli, leading to chronic kidney disease.HbA1c is the component of hemoglobin that binds to blood sugar[7].

Fasting glucose and hemoglobin HbA_1c are the standard measures for diagnosis and monitoring of diabetes[8]. Management of its modifiable risk factors might help in reducing its incidence in the nearby future[9]. It is a known fact that diabetic patients have a higher incidence of advanced stage of kidney disease[3], therefore this study aims to find correlations between HbA_1c levels with eGFR.

Materials and method :

This cross sectional study was done in the department of Biochemistry and Molecular Biology, BIRDEM Academy from July 2017 to June 2018. BIRDEM (Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders) is a multi-sectoral health care center, educational and research institute at Shahabag in Dhaka.

In this study a total of 189 respondents,both male and female subjects between the age group of 30 to 60 years were selected from outpatient department of Medicine, BIRDEM General Hospital, among them 63 healthy individuals (group I), 63 previously diagnosed type 2 diabetic patients without CKD (group II A) and 63 previously diagnosed type 2 diabetic patients with CKD (group IIB).Patients withacute kidney injury, kidney disease with non-diabetic etiology or patients on renal replacement therapy were excluded. Also pregnant women, patientshaving-nephrotoxic drug are excluded.

A structured questionnaire was filled up for each respondent after taking informed written consent. Data were collected through structured questionnaire and review of diabetic patients clinical and biochemical records from “Diabetic guide book”. Type 2 diabetic patients were previously diagnosed depending on history, clinical features and WHO criteria10.

CKD was diagnosed on the basis of persistent albuminuria (>30mg/day or ACR>30mg/g) in at least two occasions within six months period and/ or GFR less than 60 ml/min/1.73m² for more than three months[11]. Serum creatinine was measured in Jaffe’s method by Abbott ARCHITECT PLUS C 8000 auto analyzer. Estimated GFR was calculated by CKD-EPI method. HbA1c was assessed in High Performance Liquid Chromatography (HPLC) method by BIO-RAD Variant TM II Turbo.

Pearson’s correlation coefficient and ANOVA test was done to determine the relation between glycemic index and eGFR. All statistical tests were considered at 5% level of significance at SPSS (22). This study was approved by Institutional Review Board, BIRDEM.

Results :

In our study 189 participants aged 30 to 60 years were selected from outpatient department of Medicine from BIRDEM General Hospital according to inclusion criteria and divided into 3 groups based on presence and absence of DM and CKD (Group I- Healthy individuals, Group II A- patients of Type 2 DM without CKD, Group II B- patients of Type 2 DM with

CKD). 62.4% of the study subjects are male. Mean age of study subjects in healthy individuals was 45±8.66 years, and diabetic patients with and without CKD were 52±6.93years and 48±9.18 and years respectively. Most participants received some form of formal education. Only 20 people (10.6%) were illiterate. 55% of the study subjects were service holder. Monthly income of majority was 10000 to 50000 tk. Most of them lived in urban area. (Table-1)

Table I: Demographic characteristics of the study subjects (n=189)

Variables		Frequency	Percentage (%)
Gender	Male	118	62.4
	Female	71	37.6
	Illiterate	20	10.6
Education	Primary	38	20.0
	SSC	37	19.6
	HSC	37	19.6
	Graduation	57	30.2
	Laborer	9	4.8
	Farmer	4	2.1
Occupation	Service holder	104	55
	Businessman	40	21.2
	Housewife	32	16.9
Monthly income	<10,000 tk	27	14.2
	10,000-50,000 tk	140	74.2
	>50,000 tk	22	11.6
	Urban	102	54
Residence	Suburban	64	33.8
	Rural	23	12.2

Among healthy group (group I), no individuals was hypertensive. 51% of diabetic patients without CKD (group IIA) and 66.7% of diabetic patients with CKD (group IIB) had hypertension. 55.6%, 61.9% and 52.4% participants in group I, group II A and group II B had positive family history of DM. Percentages of participants who performed physical exercise in group I, group II A and group II B were 19%, 35% and 33.3% respectively. Obesity was more prevalent in group II B(22.2%) than group I (4.8%) and group II A (11.1%) (Figure-1)

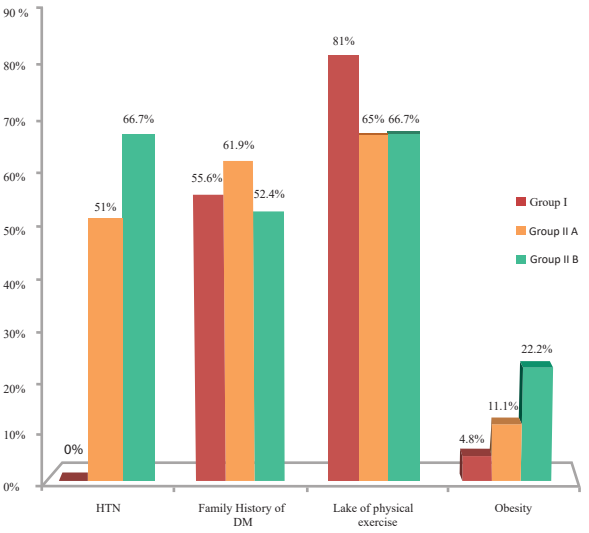

Figure 1: Frequency of different risk factors for development of CKD in 3 study groups.

In this study it was found that fasting serum glucose, HbA1c, serum creatinine and eGFR were significantly differed among three groups (group I: Healthy individuals, group IIA: Type 2 diabetic patients without CKD andgroup IIB: Type 2 diabetic patients with CKD).

Fasting serum glucose was in group I, group II A and group II B4.86±0.58, 9.07±2.93 and 10.17±4.33 mmol/L, where fasting serum glucose was highest in group II B among 3 groups. Mean HbA_1c in group I, group II A and group II B were 4.70±0.47, 7.81±1.83 and 9.00±2.51 respectively. HbA_1c was also significantly higher in group II B than group I and group II A ($p<0.001$).

Serum creatinine in group I, group II A and group II B was 0.81±0.12, 1.05±0.19 and 1.85±0.53 mg/dL respectively. Serum creatinine was significantly higher in group II B than group I and group II A ($p<0.001$). It was found that eGFR was significantly lower ($p<0.001$) in group II B than group I and group II A (40.63±13.07, 96.30±18.60 and 78.14±14.51 ml/min/m^2 respectively (Table 2)

Table 2: Comparison of biochemical variables among three groups

Variables	Group I (n=63) Mean ±SD	Group II A (n=63) Mean ±SD	Group II B (n=63) Mean ±SD	*p value
Fasting serum glucose (mmol/L)	4.86±0.58	9.07±2.94	10.17±4.33	<0.001
HbA_1c (%)	4.70±0.47	7.81±1.83	9.00±2.51	<0.001
Serum creatinine (mg/dL)	0.81±0.12	1.05±0.19	1.85±0.53	<0.001
eGFR (ml/min/1.73m^2)	96.30±18.60	78.14±14.51	40.63±13.07	<0.001

Statistical analysis was done by ANOVA test to compare among groups. Values are expressed as the mean±SD.

*= highly significant; p<0.001.

To assess the relationship between HbA_1c with eGFR, Pearson's co-relation test was done.A negative correlation was found between HbA1c with eGFR (r=-0.472, p<0.001) among the respondents which was statistically significant (Figure-2).

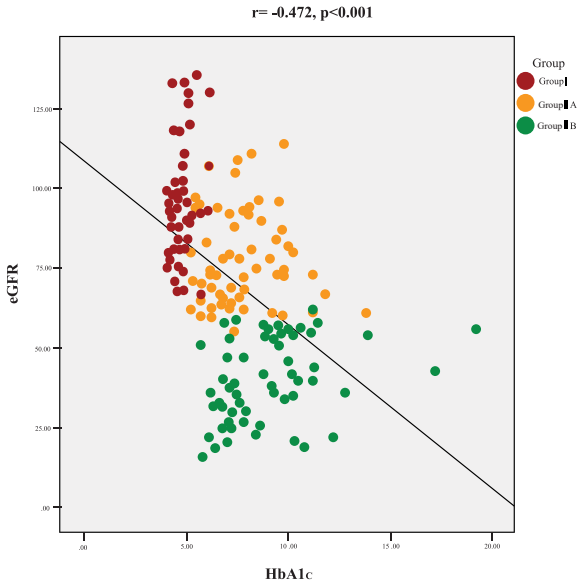

Figure 2: Correlation of HbA1c with eGFR in study subjects.

Discussion :

Diabetic kidney disease is the most common cause of chronic and end-stage kidney disease, with approximately one in three patients living with Type 2DM developing chronic kidney disease[9].

This descriptive type of cross sectional study analyzed the relationship between serum HbA_1c concentration and eGFR in healthy individuals and type 2 diabetic patients with or without CKD.189 participants aged 30 to 60 years were taken from outpatient department of Medicine from BIRDEM General Hospital according to inclusion criteria and divided into 3 groups based on presence and absence of DM and CKD (Group I- Healthy individuals, Group II A- patients of Type 2 DM without CKD, Group II B- patients of Type 2 DM with CKD). In this study49.2% of diabetic patients without CKD and 66.7% of Diabetic patients with CKD were hypertensive. Fujita et al., (2010) found that 50.7% diabetic patients without nephropathy and 86.7% diabetic nephropathy patients were hypertensive (p<0.001)[12]. In a cross sectional study in Japan among diabetic patients 45.2% participants were male and 56.2% having antihypertensive medications[13]. In our study fasting serum glucose in Healthy individuals, diabetic patients without CKD and diabetic patients with CKDwere 4.86±0.58, 9.07±2.93 and 10.17±4.33 mmol/L respectively, where fasting serum glucose was highest in diabetic patients with CKD. Serum creatinine in Healthy individuals, diabetic patients without CKD and diabetic patients with CKD were 0.81±0.12, 1.05±0.19 and 1.85±0.53 mg/dl respectively. Serum creatinine was significantly higher in diabetic patients with CKD than other two groups (p<0.001). Both these finding were consistent with the other studies[14, 15].

Mean HbA_1c was highest (9.00±2.51%) in diabetic patients with CKD. Mean HbA1c in Healthy people and diabetic patient without CKD were 4.70±0.47 and 7.81±1.83 respectively.In addition,the present study found that eGFR was significantly lower (p<0.001) diabetic patients with CKD than healthy people and diabetic patient without CKD (40.63±13.07, 96.30±18.60 and 78.14±14.51 ml/min/m^2 respectively). Similar findings were found in other studies[14, 15].

In our study. HbA_1c was negatively correlated with eGFR (r=-0.472, p<0.001) in all study subjects.

In many studies it was found that poor glycemic control has an association with the development of kidney disease in diabetic patients[16-18] and other micro vascular complications of diabetes mellitus[19].

The reason behind the development of micro vascular complication including CKD (determined by decreased eGFR) [11] in diabetic patients having poor glycemic control (determined by increased HbA_1c) may be increased oxidative stress. Oxidative stress has been considered to be a pathogenic factor for nephropathy in diabetic patients[20] as they have more severe oxidative stress than healthy person[21]. This oxidative stress generated by poor control of diabetes mellitus, characterized by hyperglycemia, that increases ROS production , which leads to the activation of various redox -sensitive cell signaling molecules and the production of cytotoxic materials. This is followed by cellular dysfunction and damage and ultimately results in diabetic micro and macro-vascular complications[22].

Limitation of the study: This study was done in a limited period of time with relatively small population and convenient sampling was used from a single center. Multicenter, longitudinal, population based study with a large sample size and longer duration is recommended for more accurate and reliable results.

Conclusion:

Our study concluded that HbA1c has a negative correlation with eGFR. It is shown that increased level of HbA_1c has a strong association with development of CKD in type 2 diabetic patients. It should be noted that, raised HbA_1c is an important investigation for the monitoring of diabetic complications and renal function test must be done for early diagnosis of CKD in diabetic patients for better management.

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