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Research Article

Glycated Hemoglobin is a Biomarker of Renal Failure in Diabetic Patients

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Abstract

Objective: In diabetic patients, this condition leads the cause the chronic kidney disease commonly known as diabetic nephropathy or diabetic kidney disease. Diabetic kidney disease patients were an exceptional cohort of the population that had a noticeable high glycated hemoglobin along with a low glomerular filtration rate.

Methodology: The recent cross-sectional study was based on a 790 participants sample size, having both normal and diabetic patients with various complications and severities related to renal function. This research is based on diabetes mellitus type 2 patients under the treatment in Farwaniyah hospital, Kuwait from 2007 to 2010. The patients were divided into four groups based on Diabetic + Renal failure (Diab+RF), Diabetic + non-Renal failure (Diab+ NRF), Nondiabetic +Renal failure (NDiab +RF) compared with normal individuals. Correlations were evaluated between HbA1c with all groups and the estimated glomerular filtration rate.

Results: In this study, we observed that higher HbA1c may the reason for the decline in glomerular filtration rate, irrespective of general characteristics like age, sex, and Blood Pressure. Our results showed that 37% of diabetic patients with renal failure. Conclusion: We report that in clinical exercise glycated hemoglobin acted as a biomarker to predict the renal disease stage. Control glucose restricts the decline in glomerular filtration rate this act shows the value of glycemic variability in glomerular filtration rate descent. endothelial damages cause by High glycated hemoglobin levels with low plasma glucose in fasting.

Keywords: Glycated hemoglobin; Diabetes mellitus; Glomerular filtration; Kidney failure.

Introduction

In the modern era, Diabetes mellitus type 2 (DMT2) showed highly prevalent along with the root cause of multifactorial and acute disease related to resistance secretion of insulin, and β-cell levels in body functioning. It indirectly increased the rate of acute diseases by developing vascular and neuropathic obstacles. The mortality rate increases globally by DMT2, 15.15% mortality was observed in Mexico in 2017. High prevalence showed that in 2035 the world suffers from DMT2 at least 15.7 million cases

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[1,2]. Diabetes mellitus is a progressive disease that can promote destruction in vascular organs i.e., Kidney, eyes, lower peripheral edema along with psychological disorders.

In diabetic patients, the chances of kidney disease have doubled as compared to no diabetic but high prevalence shown in patients having in the last decade [2]. Glycated hemoglobin is also an indicator of Peripheral Neuropathyin in diabetic patients. Its estimation also helpful in retinopathy and nephropathy [3]. Specifically, for DMT2 monitoring and evaluating glycated hemoglobin levels are recommended as a standard of care (SOC) [4]. >7.4% or <5.6% Glycated hemoglobin levels are related to diabetic patients which are higher than normal optimal levels 5.0% and 6.5% [5]. Increased Glycated hemoglobin levels prompt reduction in erythrocytes may have seen due to reduction in half-lifespan of RBC's. This condition caused accumulation of uremic toxins and decreased glucose-6-phosphate dehydrogenase (G6PD) activity in in CKD patients [6]. The albuminuria development is also caused by high glucose rather than eGFR deterioration [7].

Disturbance or difficulty in urine excretion caused the renal disorder if it proceeds it will lead to chronic kidney disease or renal failure. In diabetic patients, this condition leads to the cause the chronic kidney disease (CKD) commonly known as diabetic nephropathy or diabetic kidney disease (DKD).

Diabetic kidney disease patients were an exceptional cohort of the population that had a noticeable high albumin excretion along with a low glomerular filtration rate (GFR). This condition not only affects the kidneys but also alters normal body function. Albuminuria, bulky body, hypertension, puffiness of ankle and legs, night urination, dawn sickness, and anemia are the common symptoms of kidney disease in diabetic people [8].

Literature showed that dyslipidemia was positively correlated with diabetic nephropathy which caused renal failure because it's a progressive disorder of lipid nephrotoxicity [9]. Blood glucose increases due to unavailability or less availability of insulin glycemic control can improve the condition i.e., microvascular destruction and end-stage renal disease (ESRD) with hemodialysis in DM patients [10].

The gold evaluation standard of glycemic control is known as Glycated hemoglobin (HbA1c) that was not just regulates glycated hemoglobin concentrations but also provides the plasma history related to glycose along with the lifespan of RBCs.

The present study is based on the rationality of glycated hemoglobin as a biomarker in diabetic patients. Furthermore, the changes in glycated hemoglobin levels may lead to the chronic stage of the kidney (CKD).

It was also observed that renal dysfunction in diabetic patients is directly proportional to the variations in glycated hemoglobin levels. This research aimed to evaluate the significant variation in glycated hemoglobin levels in diabetic patients that causes renal failure. Glycated hemoglobin levels act as a biomarker of renal failure in diabetic patients.

Method and Material

Subjects

The recent cross-sectional study was based on a 790 participants sample size, having both

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normal and diabetic patients with various complications and severities related to renal function.

This research-is based on diabetes mellitus (DM type 2) patients under the treatment in Farwaniyah hospital, Kuwait from 2007 to 2010. The medical records and clinical finding analyzed on based of their clinical history such as heart attack, hypertension, hyperlipidemia, furthermore, the physical and general characteristics were also recorded such as age, sex, eGFR, Blood Pressure (BP).

The patients were divided into four groups based on Diabetic + Renal failure (Diab+RF), Diabetic+non-Renal failure (Diab+ NRF), Nondiabetic +Renal failure (NDiab +RF) compared with normal individuals. Correlations were evaluated between HbA1c with all groups and estimated glomerular filtration rate (eGFR). The description of the patients is shown in Table 1.

Biochemical estimation

Biochemical estimation of All groups was analyzed by blood samples, obtained in a fasting state. Clinical vital parameters, including complete blood count (CBC), and fasting plasma glucose (FPG) were collected. CBC and FPG were analyzed by cell counter analyzer and the hexokinase respectively.

HbA1c was determined by the D100 instrument and reagents (BioRad, Hercules, CA) and the high-performance liquid chromatography (CLC385 TM, Primus, Kansas City, MO, USA) method. The database evaluated by initial dialysis having 29-31 % prevalence when compared to with eGFR <60ml/min/1.73m^2. Some data was excluded on the bases of >120ml/min/1.73m^2. The patients were not treated with sodium-glucose inhibitor (SGLT2!) during the study period.

Statistical analysis

All groups' values were expressed as mean ± standard deviation (SD) ranges for normally distributed diabetic variables.

The relationship between HbA1c and diabetes was evaluated by univariate regression analysis. Comparisons between groups were evaluated by the student's t-test. A Statistical analysis was performed by SPSS 22.0 software with 0.05 as P-value for significance was considered.

Result

A data of 790 male patients in our population was observed in the mean age was 66.7 ± 13.5 years. The main characteristics in the study of all groups (Table 1). The study base on four groups such as Group II Diabetic + Renal dysfunction (Diab+RD), Group III diabetic + non-Renal dysfunction (Diab+ NRD), Group IV Nondiabetic +Renal dysfunction (NDiab +RD) compared with Group I normal. In which 37% was Diabetic + Renal dysfunction, diabetic + non-Renal dysfunction, Nondiabetic +Renal dysfunction compared with normal individuals.

In this study, significance showed between BMI (P>0.05), systolic blood pressure, diastolic blood pressure (P>0.03) was analyzed. Group II and Group III had a significant increase in BMI ratio as compared to the group I. Group III also a significant with Group I control by increased in systolic blood pressure (Table 1).

Comparative study between group were analyzed by one-way Anaova was performed

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by SPSS 22.0 software.in which high glycated hemoglobin level and low levels of estimated glomerular filtration rate and hemoglobin Level were showed in figure 1.

The Univariate regression analysis was performed to evaluate the relation between glycated hemoglobin and estimated glomerular filtration rate by SPSS 22.0 software (Figure 2).

FPG and HbA1c (r^2=0.40; p<.004) eGFR with HbA1c (r^2=0.35; p<.006) were observed however the HbA1c was not a significant with eGFR. While Percentile of glucose level within group showed in figure 3.

Variables	All patients
Patients,	790
Age, years	66.3 ± 13.5
SEX	male
DM duration	13.6±4.3
BMI	27.48 ± 4.6
SBP	134±18.5
DBP	85± 7.5
OAD	525 (35.23%)
Insulin	300(25%)
Antihypertensive medications	550 (75%)
Antihyperlipidemic medication	510(36%)
HbA1c	175±8.7
eGFR	250±29
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Antihypertensive medications	550 (75%)
Antihyperlipidemic medication	510(36%)
HbA1c	175±8.7
eGFR	250±29

Table 1: Characteristics of the patients' study.

DM: Diabetes mellitus DBP, diastolic blood pressure;BMI: Body Mass index; SBP, systolic blood pressure;DBP, Diastole blood pressure OAD, oral anti-diabetic druge;HbA1c, glycated hemoglobin; GFR, estimated glomerular filtration rate; Values are expressed as mean ± standard deviation or median or as percentages.

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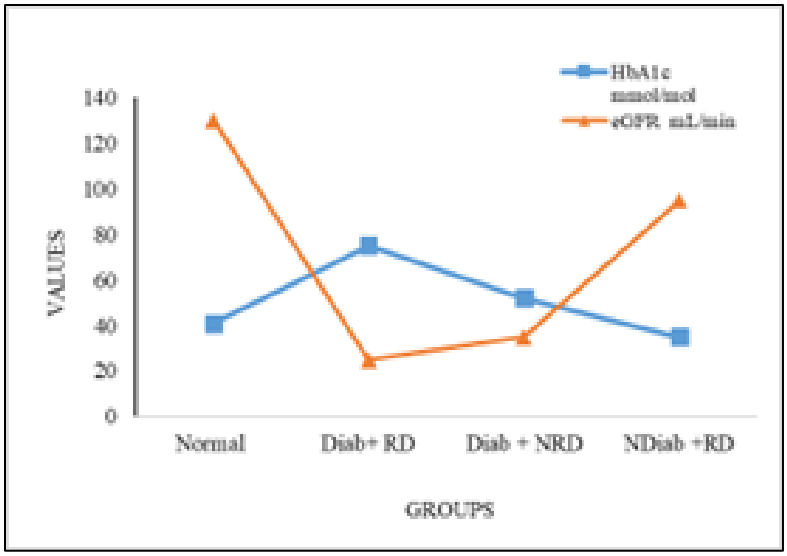

Figure 1: Comparative parameter between group. The values are represented as mean±S.D.

Where fasting plasma glucose (FPG); Glycated Hemoglobin (HbA1c); estimated glomerular filtration rate (eGFR); Hemoglobin Level (Hb). One-way Anaova was performed by SPSS 22.0 software.

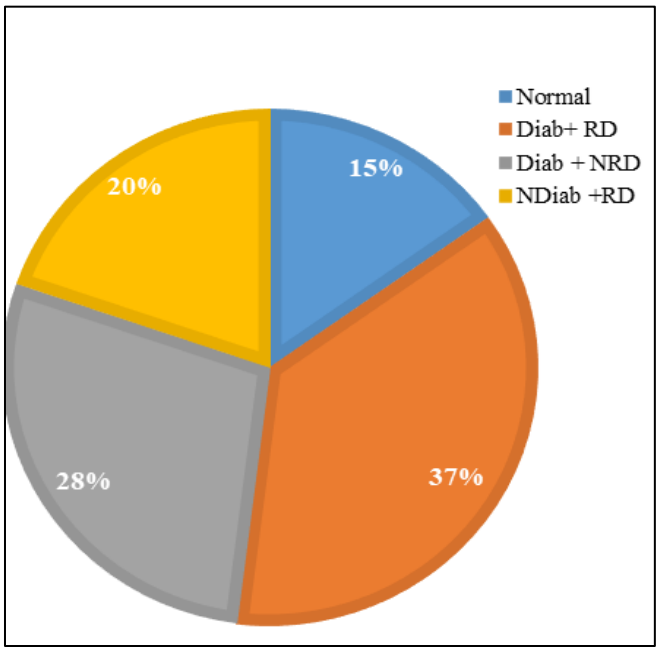

Figure 2: Comparative parameter between HbA1c, Glycated Hemoglobin; eGFR, estimated glomerular filtration rate within group.

The values are represented as mean±S.D. Univariate regression analysis was performed by SPSS 22.0 software. Where fasting plasma glucose (FPG); Glycated Hemoglobin (HbA1c); estimated glomerular filtration rate(eGFR); Hemoglobin Level (Hb). Statistical analysis was performed by SPSS 22.0 software. Diabetic + Renal dysfunction (Diab+RD), diabetic + non-Renal dysfunction (Diab+ NRD), Nondiabetic +Renal dysfunction (NDiab +RD).

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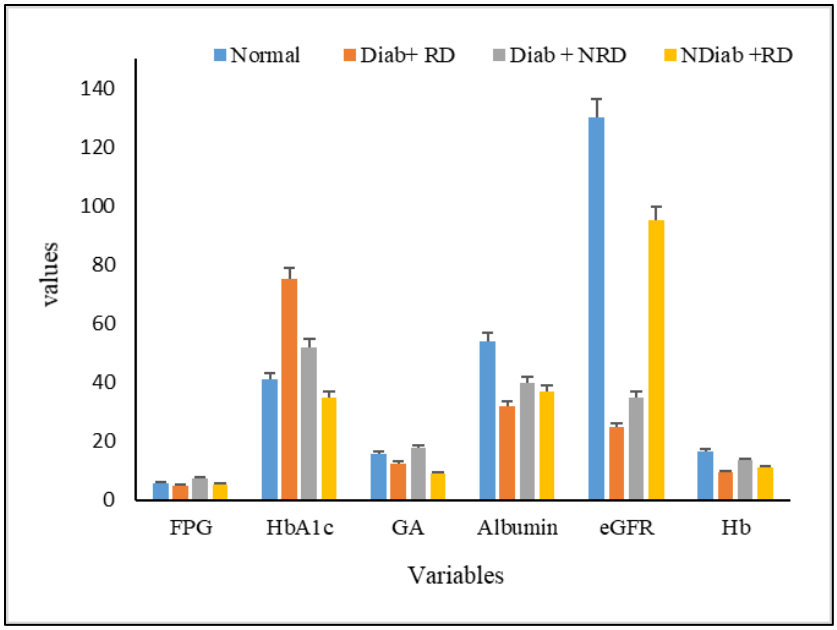

Figure 3: Percentile of glucose level within group.

Discussion

The recent research showed the eGFR decline with high glycated Hemoglobin in diabetic patients showed an inversely proportionality in CKD which leads to renal failure. Kidney dysfunctions differ person to person according to their status background. The boundaries of short sample size, FPG monitoring, eGFR levels were covered. However, significant link between glycated Hemoglobin and renal function were observed in groups (Figure 1). This association indicates that glycated Hemoglobin is a biomarker for renal failure in diabetic patients as compare with normal. To evaluate the glycated hemoglobin, we also assist the RBC's. literature showed approximately 40% of diabetes mellitus (DM type 2) while 30% of diabetes type 1 patients were at risk of diabetic kidney disease (DKD) [11,12]. DKD had a high prevalence of death cause in DM type 2 patients worldwide. Hypertension in diabetic patients leads to impairment of renal function after DKD. The kidney failure risk will be four times greater in albuminuria while the risk rate increases in reduced glomerular function and is complicated when an albuminuria condition with low GRF. Optimizing glycemic control reduces the chances of DKD [13].

Our results showed 37% diabetic patients with renal failure. Similarly, literature showed that the 11.4%, 38.8%, and 62.3% prevalence of CKD in diabetic patients in the United Arab Emirates, China (out of 15856), and India respectively [14,15]. While DKD prevalence is about 2.2%, 2.9, 34.4%, in the United States (U.S.), China, and India respectively. Similarly, 15.3% and 28% of DMT2 patients in Japan and the United Kingdom (U.K) respectively [9,16].

In this study, we observed that higher HbA1c may the reason of decline in eGFR, irrespective with general characteristics like age, sex, and BP. However, the recent study excluded eGFR range >120ml/min/1.73m2. We report that the in clinical exercise glycated hemoglobin acted as biomarker to predict the

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renal disease stage. Control glucose restrict the decline in eGFR this act shows the value of glycemic variability in eGFR descent. endothelial damages cause due to High glycated hemoglobin level with low FBS [7,17]. Similar results were described by lee in 2020 in his paper. He also addresses the metabolic memory with oxidative stress by excursions of glucose in diabetic rat. However, glucose excursions also associated with endothelial damage such as hexosamine, protein kinase C and polyol activation. In diabetic patient's glucose swing trigger oxidative stress in chronic hyperglycemia. Meta-analysis reported the independently association of glycated hemoglobin with the of renal dysfunction in both DMT1 and DMT2 patient [18]. However, most studies confounding factors for eGFR decline was not familiar.

Notably, our finding demonstrated that the glycated Hemoglobin increased level direct effect the efficacy of kidney functioning that may cause renal failure in diabetic patient. The risk of renal failure doubled in diabetic patients because of high bold glucose levels in plasma. This condition induces progressive degeneration of vital organ and increase the probability of renal failure.

Funding

No funding was acquired for this research.

Declarations

Informed consent

The data were collected with full consent from participants with agreement upon as a willingness to participate in the study. To protect the privacy of participants, all details will be obtained anonymously.

Ethical Approval

Research Ethics committee (REC) approved by this study before conducting it.

Conflict of interests

The authors have no conflict of interest.

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