Correlation between Glycosylated Hemoglobin level with Angiographic findings of Coronary Artery Disease in different ages.

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ABSTRACT:

Objective: Coronary Artery Disease (CAD) is one of major macro vascular complication of Diabetes Mellitus (DM). The object of study is to analyze the correlation of angiographic findings of CAD with changes of glycosylated Hemoglobin (HbA1c) levels in CAD Patients, T2DM Patients and Patients having both CAD and T2DM as compared to normal in different age groups.

Methodology: This cross-sectional descriptive study was conducted at Rawalpindi Institute of Cardiology (RIC) during 1st December 2020 to 28th February 2021. The study included 1540 (385 subjects in each group) from Rawalpindi Institute of Cardiology hospital presenting with symptoms of CAD. A Complete demographic data was taken. They were assessed according to HbA1c level and type of CAD based on angiographic findings. Patients were divided into 4 groups according to HBA1C ranging from <5 % to > 8.0% and 4 age groups ranging from 40 to 79 years

Result: A statistical positive correlation between HBA1c with advancing age. Most vulnerable age group was 50-59 years in all groups of altered HBA1c. A statistical correlation between Angiography findings of CAD with HBA1c was significantly positive. ($p<0.001$).

Conclusion: HbA1c can be used as a predictor of severity of coronary artery disease measured by Angiographic findings as patients with a higher level of HbA1c had significant severe lesions on Angiography.

Keywords: Coronary heart disease, type 2 Diabetes Mellitus, HbA1c, Angiographic findings in CAD.

Introduction:

Coronary Artery Disease (CAD) is one of chief predictors of mortality of Diabetes Mellitus (DM) [1]. This is one of major macrovascular complication of diabetics mainly due to unstable progressive atherosclerotic plaque formation leading to thrombus formation in major blood vessels like coronary and cerebral arteries.[2, 3] The risk of CAD can be lowered by strict glycemic control in DM which can be assessed by estimation of the blood levels of glycated hemoglobin (HbA1c) in diabetic patients.[4,5] Higher the prevalent levels of blood glucose, the higher will be the level of glycated hemoglobin. [6] HbA1c as compared to the fasting blood glucose is considered as better laboratory marker to determine risks of CAD in diabetic patients.[7] Most of the previous cohort studies showed strong relation between risks of cardiovascular diseases with glycemic controls of diabetic patients.[8] To find out the narrowing or blockage of coronary blood vessels due to atherosclerotic plaque, an invasive test, Coronary angiogram further confirms the diagnosis of CAD. [9] The patients with triple vessel CAD (TVCAD) and double vessel CAD (DVCAD) as compared to patients with single vessel CAD (SVCAD) disease had significantly greater risks of coronary vessels atherosclerosis .[10] Main risk factors for CAD other than diabetes mellitus include hypertension, smoking, lack of exercise, family history of CAD, obesity and altered lipid profile.[11, 12] It is necessary to find which specific age groups in CAD and T2DM are more likely suffer from poor glycemic control. Unfortunately, there is lack of studies in specific patient groups of Rawalpindi population to set practical goals for treatment of uncontrolled Diabetes. There is intense need of research to make Guidelines for diabetic patients of different age and gender groups to prevent macrovascular complications especially cardiovascular events.

Objective: To analyze the correlation of angiographic findings of CAD with changes of glycosylated Hemoglobin (HbA1c) levels in CAD Patients, T2DM patients and patients having both CAD and T2DM as compared to normal in different age groups.

Methodology:

This cross-sectional descriptive study was carried out at Rawalpindi Institute of Cardiology (RIC) for a period of 6 months, from 1st December 2020 to 28th February 2021. After approval from ethical committee of RIC, written informed consents were taken from patients presenting with chest pain. Patients of either gender aged between 40 to 79 years having type 2DM (confirmed by HbA1c Levels), coronary artery disease (CAD) (confirmation by coronary angiogram) and those having both type 2DM and CAD were included for the current study. Patient with history of type 1DM were excluded. Those patients having normal angiographic finding and those having atherosclerotic lesions in coronary arteries were considered as separate groups.

Demographic data of all patients was recorded in pre designed proforma and their blood samples were collected for determination of HbA1c levels with standard techniques. Coronary angiography of all patients was performed by cardiologist of RIC as per standard protocol of the hospital. These angiograms were finally reassessed by senior cardiologist to identify stenotic plagues in coronary vessels. Stratification was done on the basis of HbA1c ranging from <5 % to > 8.0%, on the basis of age of the patient and on

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the basis of atherosclerotic lesions of affected coronary vessels. Stratification of the patients was done based upon of the First grouping of patients was done on the basis of HbA1c (ranging from <5 % to > 8.0%), age (ranging from 40 to 79 years) and presence and absence of atherosclerotic lesions of affected coronary vessels. Based upon finding of the angiogram patients were grouped into two, those whose angiography was normal were considered as group 1 and those having atherosclerotic lesions in coronary arteries were considered in group 2.

All statistical analysis of demographic data, reports of HbA1c test and coronary angiography findings were assessed by SPSS 25.

Results:

Out of 1540 Study people, majority of people (52%) having normal glycemic index were of 40-49 years. Whereas 44% people aged between 50-59 years were pre-diabetes, diabetic with good control (51%), diabetic with fair control (45%) and diabetic with poor control (49%). HbA1c showed highly significant correlation with age of study population (p<0.001). A statistical correlation between Angiography findings of CAD with HBA1C was significantly positive. (p<0.001).

Table No 1: Distribution frequency and percentage of age groups in ranges of HbA1c.

	HbA1c	40-49 years	50-59 years	60-69 years	70-79 years
1	Normal (<5.7%)	401 (52%)	322 (41%)	44 (09%)	3 (38%)
2	Prediabetes (5.7% - 6.4%)	19 (38%)	22 (44%)	8 (16%)	0 (00%)
3	Diabetic with good control (6.0 - 7.0%)	128 (33%)	182 (51%)	40 (11%)	4 (01%)
4	Diabetic with fair control (7.1% - 8.0%)	77 (39%)	89 (45%)	29 (14%)	2 (01%)
5	Diabetic with poor control (> 8.0%)	59 (34%)	84 (49%)	25 (14%)	2 (01%)

Table No 2: HbA1c correlation with Age groups.

HbA1c	Age Groups	R value of correlation	*p-value*
		55.317	.000

**. Correlation is significant at the 0.001 level (2-tailed).

Table No 3: HbA1c correlation with Angiographic findings of coronary vessels.

HbA1c	Angiographic findings	R value of correlation	*p-value*
		21.751	.000

Table No 4: HbA1c correlation with Angiographic findings of coronary vessels..

	HbA1c	Normal Coronary arteries	Abnormal Coronary arteries
1	Normal (<5.7%)	385(25%)	385(25%)
2	Prediabetes (5.7% - 6.4%)	40(03%)	1(0%)
3	Diabetic with Good Control (6.0 - 7.0%)	172(11%)	182(12%)
4	Diabetic with Fair Control (7.1% - 8.0%)	89(06%)	108(07%)
5	Diabetic with Poor control (> 8.0%)	84(05%)	86(06%)

**. Correlation is significant at the 0.001 level (2-tailed).

Discussion:

The results of this study showed that the uncontrolled glycemic levels indicated by raised HbA1c levels had a statistically significant impact on increase narrowing of coronary blood vessels among adults presented at RIC. These findings are in line with other cohort studies signifying the relation between HbA1c level and macrovascular complications in type 2 diabetes patients .[13] Increased glycemic levels causes sluggish blood flow and drives inflammation due to damage of tunica intima and media of endothelium of blood vessels leading to scarring and narrowing of coronary blood vessels. [14] Our findings were dissimilar with cohort studies in which glycemic level in patients was compared with different types of vascular diseases.[15] In contrast, a strong relation was observed between HbA1c level and cardiovascular events predicting that HbA1c may be considered as more appropriate predictor when compared to fasting blood glucose level. [16]

The findings of published studies exploring association between HbA1c level in patients with and without T2DM and cardiovascular events in CAD patients after cardiac interventions are in line with our findings. In these studies, this relation was found in patients without known type 2 diabetes. [17,18] A likely mechanism triggering cardiovascular events of atherosclerosis was proved by raised inflammatory biomarkers. [18]

An increased level of HbA1c is associated with elevated inflammatory activity indicated by raised total leukocyte counts, fibrinogen, C-reactive protein and D-dimer levels. These inflammatory dynamics either alone or in combination associated with raised blood glucose status in previous 2-3 months, had significant role on the advancement of atherosclerotic coronary artery disease and adversarial cardiovascular events. [19] The most vulnerable age group during current study is middle age which shows that with increasing age T2DM patients are more prone to develop cardiovascular complications evidenced by previous studies.[20] The dissimilarity between findings of current study with previous studies is the difference in study population. The current study comprised patients of age ranges between 40 to 80 years as compared to previous cohort studies having younger patients with vascular disease other than coronary vessels. [21] Previous cohort study showed a relationship of severe cardiovascular events and arrhythmia with hypoglycemia in T2DM.[22]

Although hyperglycemia is the most important factor for progressive vascular damage other factors like altered lipid profile, hypertension, obesity and smoking have been found to be strongly related to cardiovascular pathogenesis in T2DM patients.[23]

Our study is novel in a sense that it was first time conducted in population of Rawalpindi. HbA1c plays an important role in reflection of blood glucose status of last 6 months. This biomarker is taken as the gold standard in prediction of atherosclerotic and coronary artery disease. To reduce burden of heart disease in Pakistani population, we need to ensure awareness of preventive measures by strict glycemic control and adherence to life style modifications.

Conclusion:

Our study concludes that inadequate glycemic control, as evidenced by elevated HbA1c levels, contributes to the development of coronary artery blockage in patients with type II Diabetes Mellitus as they age.

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Conflict of interest: none

Limitations of study: The present investigation is a single-center study conducted at RIC, involving a limited cohort of patients. This raises the question of whether the findings accurately represent the broader population of individuals with T2DM. Additionally, it is important to note that patients with type 1 diabetes were excluded from this study, as stringent glycemic control has been shown to correlate with a reduction in cardiovascular events in that group. Furthermore, our research did not address other microvascular and macrovascular complications associated with T2DM, focusing solely on coronary vessels. Given that microvascular complications have been closely linked to HbA1c levels, it is essential to assess the importance of rigorous glycemic control in patients with type 2 diabetes and related vascular conditions.

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