Research Article

Association of HbA1c with Diabetic Retinopathy in Diabetic Patients

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Abstract

Background: Retinopathy due to diabetes is increasing in patients due to increase prevalence of diabetes.

Objective: We tried to find if there is any association of HbA1c with Diabetic Retinopathy in diabetic patients of Kharian.

Methods: This study was conducted in OPD medical department of THQ hospital Kharian after getting approval letter (CKMC/IERB/AC-00104) from Institutional Ethical Review Board of CMH Kharian Medical College. Consent was taken from 150 randomly selected diabetic patients. It was a cross-sectional study from 10 Oct 2023 to 10 Jan 2024. History was taken from the patient to know their parameters of age, gender, duration of diabetes. Indirect fundoscopy of all patients was performed to assess the status of retinopathy. We checked HbA1C, random blood glucose levels of patients.

Results: All 150 diabetic patients were examined for diabetic retinopathy. Diabetic retinopathy was prevalent among 50 % of the participants. 75 patients had diabetic retinopathy. Significant association was found between diabetic retinopathy and HbA1c levels of HbA1c ($p = 0.001$). Duration of diabetes mellitus and family history of diabetes was also significantly associated with diabetic retinopathy ($p = 0.001$).

Conclusion: One-half of the diabetic patients in our study had retinopathy. Levels of HbA1c and duration of diabetes mellitus are demonstrated as undeniable risk factors for Diabetic Retinopathy and can be used for screening to prevent blindness due to diabetic retinopathy.

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Introduction

Diabetes mellitus is a disease linked with hyperglycemia due to lack of insulin.[1] Persistent hyperglycemia due to diabetes mellitus results in micro vascular and macro vascular complications that lead to damage or altered organs such as retina, nephrons of kidneys,axon of nerve fibres and heart.[2] Chronic hyperglycemia due to insufficient insulin secretion or insulin resistance leads to serious chronic complications.[3] High blood glucose levels damages retina resulting in retinopathy.[4] The prevalence of diabetes mellitus in Pakistan reached more than 40% in 2023(fifth highest worldwide) due to various factors.[5] Risk factors for diabetic retinopathy include lipid profile, blood glucose control, hypertension, smoking, patient age, the duration of diabetes, ethnicity and genetics.[6]

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Diabetic retinopathy affects more than 50% of diabetics and eventually results in blindness.[7] Retinopathy is graded into two stages. Non-proliferative stage is characterized by micro vascular leakage and occlusion leading to macular swelling and ischemia.[8] Proliferative stage is symptomatic and results from growth of new blood vessels, floaters, blurring or complete loss of vision.[9]

Diabetic retinopathy is a vascular disease but its pathogenesis is still under research. Persistent high blood glucose levels and chronic inflammation damage retina by disturbing regulation of various neurotrophic and growth factors in the eye that leads to development of retinopathy.[10]

Valine N terminal of hemoglobin becomes glycosylated by glucose concentration in the blood resulting in the formation of hemoglobin A1C (HbA1c). HbA1a and HbA1b are other lesser glycated fractions. It is usually expressed as percentage of total hemoglobin. HbA1c is used to find out glycemic control of last three months as per American diabetic association.[11] HbA1c in non-diabetics range from 4% to 6%. American Diabetes Association (ADA) recommends HbA1c < 7.0%.[12]

The objective of this study is to find any association between diabetic retinopathy and HbA1c levels of more than > 6.5%. At present HbA1c is the best marker to detect of diabetic retinopathy. Moreover it is still not proven that HbA1c is directly associated with severity of diabetic retinopathy. Other markers like BNP, serum Magnesium levels and incretins[13] etc are also under research to detect severity of diabetic retinopathy to prevent complications like blindness.[14] A study done by Zhou et al showed that there might be a relationship between triglyceride-glucose (TyG) index and diabetic retinopathy.[15]

A study done at Prince Majid Diabetic Centre ,Madina ,Saudia showed a 26.9% prevalence of retinopathy in diabetics patients.[16] Perais et al reported that increased HbA1c levels increase the progression to proliferative diabetic retinopathy. It also reported that renal impairment patients, patients diagnosed with diabetes mellitus at a earlier age are increased risk to progress to proliferative diabetic retinopathy.[17] A study in USA showed a prevalence of 26.43 among people with diabetes.[18] Another study done in USA in 2024 by Liu et al showed negative correlation between cardiovascular health and retinopathy.[19] A study done by Hou Xuhong et al. in China showed that diabetic retinopathy was also associated with education levels, household income, and multiple dietary intakes.[20]

Methods

This study was done in OPD medical department of THQ hospital Kharian after getting approval letter (CKMC/IERB/AC-00104) from Institutional Ethical Review Board of CMH Kharian Medical College. It was a cross-sectional study from 10 Oct 2023 to 10 Jan 2024. After taking informed consent, physical Exam of patient was performed to look for other side effects of diabetes. After applying mydriatic eye drops Indirect fundoscopy of all patients was performed to detect the presence of diabetic retinopathy. Status of Diabetes was confirmed from lab investigations on patient file. We checked HbA1C, random & fasting blood glucose levels of patients.

The sample size was calculated by using the WHO sample size calculator using confidence internal of 95% , margin of error 5% . We got a sample size of 150 patients. 8The inclusion criteria was age more than 18 years, diabetic patients. Patients with gestational diabetes , patients with hypertensive retinopathy or retinal disease due to any other cause were excluded . We got 198 patients . 48 were excluded. Questionnaire included information about gender, age, smoking habits, history of diabetes in family, duration of DM, history of hypertension, renal impairment, history of heart disease (CAD) and total Cholesterol.

IBM-SPSS was used to study the relationship between different parameters of the patients with Diabetic Retinopathy . Logistic regression test was applied. Statistically significance was set at p- value of less than 0.05.

Results

Out of 150 diabetic patients who attended the OPD clinic from Oct 2023 to January 2024. Most of the

patients were males (96) with a mean age of 48.9±15.3 years and 54 were females with a mean age of 52±15.0. Out of 150 diabetic patients 75 patients (50%) had diabetic retinopathy .Most of these patients had Grade 1 mild retinopathy. 45 patients had non proliferative diabetic retinopathy (NPDR) . Only 30 patients had Proliferative Retinopathy.

Significant association was found between diabetic retinopathy and HbA1c levels (p <0.001). The duration of Diabetes mellitus(p <0.001) and family history of diabetes (p value<0.001) were also significantly associated with diabetic retinopathy (p value <0.001). Significant association was found between history of hypertension (p value < 0.001) and history of heart disease (p value <0.001) also. Significant association was found between smoking and total cholesterol of patients. Renal impairment was found to have no significant relationship with diabetic retinopathy.

Table 1: *Relationship between diabetic retinopathy and the studied parameters using logistic regression*

Variable	Total	Diabetic		OR	95% CI	P VALUE
		YES	NO			
Duration of Diabetes						
1-5 years	74	9 (12%)	65 (87%)	47.7	18.2-124.9	<0.001
≥5 years	76	66(87%)	10(13%)			
HbA1c level						
< 7%	45	1(2%)	44(98%)	105	13.8-796.5	<0.001
≥ 7%	105	74(70%)	31(30%)			
Gender						
Male	96	42 (44%)	54(56%)	2.02	1.02-3.99	0.043
Female	54	33 (61%)	21(39%)			
Family history of DM						
YES	107	66(62%)	41(38%)	6.08	2.65-13.97	<0.001
NO	43	9(21%)	34(79%)			
Historyof Hypertension						
YES	83	53(64%)	30(36%)	3.61	1.83-7.12	<0.001
NO	67	22(33%)	45(67%)			
History of Heart disease						
YES	33	29 (88%)	4(12%)	11.12	3.69-33.9	<0.001
NO	117	46(39%)	71(61%)			
History of kidney failure						
YES	18	11(61%)	7(39%)	1.67	0.61-4.57	0.319
NO	132	64(48%)	68(52%)			
Smoking						
Non smoker	117	50(43%)	67(57%)	4.12	1.74-10.1	0.001
Smoker	33	25(72%)	8(28%)			
Total cholesterol						
YES	109	45(42%)	64(58%)	0.258	0.117-0.568	0.001
NO	41	30(73%)	11(27%)			

Table 2: *prevalence of diabetic retinopathy*

Retinopathy	Number of patients	%
NO diabetic retinopathy	75	50%
MILD /Non Proliferative Diabetic Retinopathy	45	30%
MODERATE/ Proliferative Diabetic Retinopathy	30	20%

Discussion

Our study showed that 50% of diabetic patients had diabetic retinopathy. A study done at Prince Majid Diabetic Centre, Madina, Saudia showed a prevalence of 26.9%.[14] A study done in India by Lokesh et al showed a prevalence of 68% in Indian males and 32% in Indian females.[15]

Diabetic retinopathy has many risk factors such as diabetic disease duration, hypertension ,glycemic control, nephropathy, smoking, eye surgery etc. HbA1c levels show glycemic control of the patient. Below 7 show excellent control and above 7 show bad control. Our study tried to find a relationship between these risk factors and diabetic retinopathy.

Our study showed that there is a significant association between diabetic retinopathy and levels of HbA1c (p=0.001). Sigamani et al. showed a association between poor glycemic control and higher incidence of diabetic retinopathy.

Patients with HbA1c levels more than 7% had 105 times more chance to develop retinopathy than those with HbA1c levels less than 7%.Similar results were mentioned by Almutairi et al. We also found that patients with diabetes mellitus duration more than 5 years were 48 times more likely to develop retinopathy. There is a significant association between duration of diabetes and diabetic retinopathy (p value =0.001). Almutairi et al study showed similar results.[14]

There was no statistical difference between diabetic retinopathy and gender (0.534). These finding are similar to other studies such as Almutairi et al which also showed no significant association between diabetic retinopathy and gender. Our statistical analysis showed significant relationship between diabetic retinopathy and serum cholesterol levels (P value 0.001). There was significant association between smoking cigarettes and development of diabetic retinopathy.

Previous studies have showed significant association between hypertension and diabetic retinopathy. Hypertension worsens diabetic retinopathy. Our study showed that there is significant relationship between history of hypertension and retinopathy (p value 0.001). The study in Saudia also found no evidence of heart disease in diabetic retinopathy prevalence.[14] Furthermore surprisingly there was not any significant relationship between kidney disease and diabetic retinopathy (0.319).

It was a single centre study. We did not check the severity of HbA1c with the grades of diabetic retinopathy. Other markers could have been checked to check severity of diabetic retinopathy.

Conclusion

We conclude that there is a direct relationship between HbA1c levels and diabetic retinopathy. Diabetic retinopathy is a serious complication of diabetes than can lead to vision loss and blindness. Early detection is crucial to prevent vision loss and improve patient outcomes.

Ethical Approval: The Institutional Ethical Review Board, CMH Kharian Medical College Kharian Cantt, Pakistan, approved this study vide letter No. CKMC/IERB/AC-00104.

Conflict of Interest: None

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Author Contribution

SI: Conception & design, acquisition of data, drafting of article, critical revision for important intellectual content, final approval

AA: Acquisition of data, analysis & interpretation of data, drafting of article, critical revision for important intellectual content, final approval

SH: Acquisition of data, drafting of article, critical revision for important intellectual content

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