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OBSERVATIONAL RESEARCH TO ASSESS THE ASSOCIATION OF HbA1c LEVELS WITH DIABETIC RETINOPATHY

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ABSTRACT

Aim: The aim of the present study was to evaluate the association of HbA1c levels with diabetic retinopathy.
Methods: The present study was conducted in the Department of ophthalmology for 1 year after taking the approval of the protocol review committee and institutional ethics committee. 200 patients were included in the present study.
Results: There were 120 males and 80 females in our study group, revealing a male predominance in our recruited study population. The mean age of participants in this study was 62.08 ± 7.20 and out of the 200 participants. The mean age of 100 patients at diagnosis was 48.4± 6.32 and mean duration of diabetic age was 16.32 ± 6.90. The mean of Glycosylated haemoglobin (HbA1c) in the study population was 8.90 ± 1.88. The present study constituted 10% mild NPDR, 20% moderate NPDR, 45% severe NPDR, 20% PDR and 5% high risk PDR. Out of 100 retinopathy patients studied severe and very severe NPDR accounted for nearly half the patients while the other half consisted of early PDR, mild and moderate NPDR, the latter being higher than the former.
Conclusion: The value of glycosylated haemoglobin (HbA1c) showed an increasing trend as severity of diabetic retinopathy increases. The poor metabolic control as demonstrated by high HbA1c is significantly associated with severity of retinopathy and presence of CSME.

Keywords: HbA1c, Diabetic Retinopathy, Metabolic Disorders

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1. INTRODUCTION

According to WHO, Diabetes Mellitus refers to a group of metabolic disorders that share the phenotype of hyperglycemia and is defined as when a person has more > 2 readings of fasting plasma glucose of 126 mg/dl or 2-hour post-prandial glucose level >200 mg/dl or glycosylated haemoglobin (HbA1c) > 6.5%. This prolonged hyperglycemia is result from the defect in insulin secretion, insulin action or both DM is classified into 2 categories[1]: Type 1 is an Insulin dependent diabetes mellitus (IDDM) accounting for about 10% of DM cases and Type 2 which is non-insulin dependent diabetes mellitus (NIDDM) accounting for about 90% of cases. Data from the 2015 International Diabetes Federation Atlas report that DM affects 415 million people globally. With uncontrolled population increasing daily, more caloric consumption and with advancement in technology people shifting towards sedentary lifestyle, this number is projected to reach 640 million by 2040, making diabetes as one of the largest global health issues of 21st century.[2] India is considered as world capital of Diabetes.

Diabetes mellitus (DM) is considered to be a significant public health problem globally as its incidence has increased dramatically in recent years.[3] In addition to the mordant effect of DM on individuals, it also places a heavy economic burden on countries.[4] The World Health Organization defines DM as a fasting plasma glucose ≥ 7.0 mmol/l (126 mg/dl) or two-hour plasma glucose ≥ 11.1 mmol/l (200 mg/dl).[5] The symptoms of DM are usually less marked in the early stages, so most patients are diagnosed when they already have complications.[6,7] According to WHO, India has about 70 million people living with diabetes in 2015, increasing to 98 million by 2030.[8] Diabetic retinopathy is among the most common causes of legal blindness affecting the age group of 20-74 years of age and is a frequent microvascular complications of DM.[9] The prevalence of DR is considerably higher in type 1 than in type 2 DM, seen in all patients of type 1 & 70% of type 2 DM after 15 years of DM.[10,11]

Patients suffering from retinopathy are initially asymptomatic but gradually experience floaters, distortion and blurred vision which may later progress to irreversible changes. The relative risk of blindness in diabetes patients is approximately 5 times the risk of those without diabetes after adjusting for potential confounders.[12]

When glucose is bound non-enzymatically to a terminal portion of Hb chain, its quantization becomes possible. This measurement is directly proportional to blood glucose concentration.[13] As life span of RBCs is 120 days, this test, with allowances for the dynamics of RBCs production & disposal, indicate mean blood glucose over a 2- 3month period. At present, the consensus on best method for measuring glycosylated haemoglobin is to use a fractionated value of HbA1c. The normal value of HbA1c is < 6.9% of total haemoglobin. DR is one of the most common causes of blindness, therefore there should be an effort for early diagnosis and treatment of DR. Poor glucose control is a risk factor and glycosylated haemoglobin indicates long term blood glucose concentration.

The aim of the present study was to evaluate the association of hba1c levels with diabetic retinopathy.

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2. METHODS

The present study was conducted in the Department of ophthalmology for 1 year after taking the approval of the protocol review committee and institutional ethics committee. 200 patients were included in the present study.

Inclusion criteria

- Participants diagnosed to have type 2 diabetes mellitus with retinopathy changes in the fundus are included in this study.
- Recent HbA1 c levels of the participants known.

Exclusion criteria

- Participants with known other systemic diseases which could manifest as retinal pathology.
- Participants with very hazy ocular media (i.e., ocular fundus not clearly visible by indirect ophthalmoscopy) are excluded from the study.
- Gestational diabetics and juvenile diabetics.
- Undergone laser photocoagulation therapy.
- Participants not accepting the informed consent

Methodology

A general physical examination was performed followed by a complete ophthalmic examination. A detailed fundus evaluation was performed using a direct ophthalmoscopy, indirect ophthalmoscopy along with slit lamp biomicroscopy with +90D lens. FBS and Glycosylated hemoglobin (HbA1c) were investigated in lab. Glycosylated haemoglobin (HbA1c) was measured by Daytona auto analysis set. It is expressed in percentage (%).

Statistical methods

Analysis of variance test was used to determine the relationship between HbA1c and severity of retinopathy in patients of type 2 DM. Chi Square test was used to determine the relationship between severity of diabetic retinopathy with visual acuity and duration of diabetes.

3. RESULTS

Table1: Demographic and clinical data of study population

Parameters	Observation
Total number included	200
Male /female	120/80
Mean age (years)	62.08±7.20
Mean age at diagnosis (years)	48.4±6.32
Mean duration of diabetes (years)	16.32±6.90
Mean HbA1c(%)	8.90±1.88

The above table shows the demographic data of 200 patients included in our study. There were 120 males and 80 females in our study group, revealing a male predominance in our recruited study population. The mean age of participants in this study was 62.08 ± 7.20 and

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out of the 200 participants. The mean age of 100 patients at diagnosis was 48.4± 6.32 and mean duration of diabetic age was 16.32 ± 6.90. The mean of Glycosylated haemoglobin (HbA1c) in the study population was 8.90 ± 1.88.

Table 2: Prevalence of retinopathy

Retinopathy	**No of patients**	**Percentage (%)**
Mild NPDR 15 15	20	10
Moderate NPDR 19 19	40	20
Severe NPDR 50 50	90	45
Early PDR 12 12	40	20
High risk PDR 4 4	10	5

The present study constituted 10% mild NPDR, 20% moderate NPDR, 45% severe NPDR, 20% PDR and 5% high risk PDR. Out of 100 retinopathy patients studied severe and very severe NPDR accounted for nearly half the patients while the other half consisted of early PDR, mild and moderate NPDR, the latter being higher than the former.

Table 3: Correlation of HbA1c with severity of Retinopathy

Severity of retinopathy					
HbA1c range (%).	**Mild NPDR**	**Moderate NPDR**	**Severe NPDR**	**Early PDR**	**High Risk PDR**
6.5-8.5	18	18	10	15	3
8.5-10.5	2	14	50	20	5
10.6-12.5	0	2	25	5	2
12.6-14.5	0	6	5	0	0
Total	20	40	90	40	10

The above table reveals that there were 90% of mild NPDR cases, 45% of moderate NPDR cases and 11.12% of PDR cases in 6.5% - 8.5% range of HbA1c.Whereas in HbA1c range of 8.6% - 10.5%, mild and moderate NPDR cases reduced to 10% and 35% respectively and severe NPDR cases increased to 55.55%. And high-risk PDR cases rose from 30% to 50% when HbA1c rises from 6.5% - 8.5% to 8.6 %- 10.5%. This revealed an increasing trend of severity of retinopathy with raise in HbA1c levels.

4. DISCUSSION

The increased prevalence of diabetes mellitus (DM) worldwide has lead diabetic retinopathy (DR) as the leading cause of visual impairment in working-age individuals.[14-16] The longer duration and poor glycaemic control along with blood pressure fluctuations have been established as primary risk factors responsible for the development and progression of DR in various population-based studies.[17]

Diabetic Retinopathy [DR] is one of the most common microvascular complications in patients with Diabetes and it is the leading cause of visual impairment. Population‑based

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studies suggest that one‐third of the diabetic patients have signs of DR and one‐tenth have vision‐threatening states of DR, such as Diabetic Macular Edema [DME] and Proliferative Diabetic Retinopathy [PDR].[18] The incidence of DR in Type 1 Diabetes (T1DM) is 71‐90%, whereas in Type 2 Diabetes (T2DM) it is around 67% after 10 years of onset of diabetes.[19]
A south Indian study by Mohan R. reported an overall prevalence of 14 percent, NPDR 6%, while 4% had macular oedema and 4% had PDRA.[20] Chennai study revealed the prevalence of DR was 34.1%. The prevalence included 30.8% with NPDR, 3.4% with PDR and 6.4% had DME.[21] The differences in the findings could be attributed to variable population Characteristics as age of onset, diabetic duration, treatment and its adherence. Our study revealed that means values of HbA1c in non-proliferative types of diabetic retinopathy have indisputable difference.
The standard deviation of each level being considerably small made the difference more relevant. One way distribution of HbA1c in our study among the levels of retinopathy revealed significant non homogeneity and further revealed that the transition from mild to severe NPDR was statistically highly significant and that from moderate to severe NPDR was significant. Two-way distribution of retinopathy among ranges of HbA1c revealed significant association with the severity of retinopathy. The glycemic status of the patients in this study was studied by measuring HbA1C levels. When the HbA1C values were compared in the groups with increasing severity of retinopathy, increasing levels of HbA1C were noted showing a significant correlation. Therefore, it was noted that poor glycemic control led to the worsening of the retinopathy.
These studies mentioned that glycemic control was protective for all levels of retinopathy and there was no glycemic threshold below which a reduction in microvascular complications was not observed.[22-24] Comparison of the means of HbA1c in patients with and without CSME revealed statistically significant association of CSME with HbA1c. High glycosylated hemoglobin (HbA1c) level is a well-known risk factor for diabetic macular edema. In addition, the DCCT had demonstrated that intensive treatment to maintain blood glucose levels at a normal range reduced the risk of clinically significant macular edema at the rate of 23%.[25,26]

5. CONCLUSION

The value of glycosylated haemoglobin (HbA1c) showed an increasing trend as severity of diabetic retinopathy increases. The poor metabolic control as demonstrated by high HbA1c is significantly associated with severity of retinopathy and presence of CSME. Duration of diabetes and high HbA1c levels are found to be the major predictors of diabetic retinopathy in type II diabetes mellitus. The risk factors like duration of diabetes, glycemic control, systolic blood pressure, family history, and diabetic nephropathy showed strong association with presence of DR.

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6. REFERENCES

1. Powers A, Niswender K, Molina C. Diabetes Mellitus: Diagnosis, Classification, and Pathophysiology. In: Harrison's Principles of Internal Medicine. Mcgraw-Hill Medical; 2020. p. 2580–58.
2. International Diabetes Federation. IDF Diabetes Atlas, 7th edition. Brussels, Belgium: International Diabetes Federation; 2015.
3. Nakagami T, Takahashi K, Suto C, Oya J, Tanaka Y, Kurita M, Isago C, Hasegawa Y, Ito A, Uchigata Y. Diabetes diagnostic thresholds of the glycated hemoglobin A1c and fasting plasma glucose levels considering the 5-year incidence of retinopathy. Diabetes research and clinical practice. 2017 Feb 1;124:20-9.
4. IDF Diabetes Atlas 7th Edition . (2015). Accessed: January 5, 2019.
5. Definition and Diagnosis of Diabetes Mellitus and Intermediate Hyperglycemia: Report of a WHO/IDF Consultation.
6. Al Rasheed R, Al Adel F. Diabetic retinopathy: Knowledge, awareness and practices of physicians in primary-care centers in Riyadh, Saudi Arabia. Saudi Journal of Ophthalmology. 2017 Jan 1;31(1):2-6.
7. Scanlon PH, Aldington SJ, Stratton IM. Epidemiological issues in diabetic retinopathy. Middle East African journal of ophthalmology. 2013 Oct;20(4):293.
8. Pandey SK, Sharma V. World diabetes day 2018: Battling the Emerging Epidemic of Diabetic Retinopathy. Indian J Ophthalmol. 2018;66(11):1652–3.
9. Fong DS, Aiello LP, Ferris FL, Klein R. Diabetic Retinopathy. Diabetes Care. 2004;27(10):2540–53.
10. Yau JW, Rogers SL, Kawasaki R. Global prevalence and risk factors associated with Diabetic Retinopathy. Diabetes Care. 2012;35(3):556–64.
11. Fong DS, Aiello L, Gardener TW, King GL, Blankenship G, Cavallerano JD, et al. Retinopathy in diabetes. Diabetes Care. 2004;27(1):84–7.
12. Bhavsar AR, Emerson GG, Emerson MV. Epidemiology of diabetic retinopathy. In: Browning D, editor. Diabetic Retinopathy: Evidencebased Management. New York: Springer; 2010. p. 53–75.
13. Klein R, Klein BE, Moss SE, Davis MD, De Mets DL. Glycosylated hemoglobin predicts the incidence and progression of diabetic retinopathy. JAMA.1988;260(19):2864–71.
14. Antonetti DA, Klein R, Gardner TW. Mechanisms of disease diabetic retinopathy. New England Journal of Medicine. 2012 Mar 29;366(13):1227-39.
15. Guariguata L, Whiting DR, Hambleton I, Beagley J, Linnenkamp U, Shaw JE. Global estimates of diabetes prevalence for 2013 and projections for 2035. Diabetes research and clinical practice. 2014 Feb 1;103(2):137-49.
16. Trento M, Passera P, Trevisan M, Schellino F, Sitia E, Albani S, Montanaro M, Bandello F, Scoccianti L, Charrier L, Cavallo F. Quality of life, impaired vision and social role in people with diabetes: a multicenter observational study. Acta Diabetologica. 2013 Dec;50(6):873-7.

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17. Klein R, Klein BE. Blood pressure control and diabetic retinopathy. British Journal of Ophthalmology. 2002 Apr 1;86(4):365-7.
18. Lamoureux EL, Wong TY. Diabetic retinopathy in 2011: further insights from new epidemiological studies and clinical trials. Diabetes care. 2011 Apr 1;34(4):1066-7.
19. Klein R, Klein BE, Moss SE, Cruickshanks KJ. Relationship of hyperglycemia to the long-term incidence and progression of diabetic retinopathy. Archives of internal medicine. 1994 Oct 10;154(19):2169-78.
20. Dandona L, Dandona R, Naduvilath TJ, McCarty CA, Rao GN. Population based assessment of diabetic retinopathy in an urban population in southern India. British Journal of Ophthalmology. 1999 Aug 1;83(8):937-40.
21. Rema M, Ponnaiya M, Mohan V. Prevalence of retinopathy in non insulin dependent diabetes mellitus at a diabetes centre in southern India. Diabetes research and clinical practice. 1996 Sep 1;34(1):29-36.
22. Sacks DB, Bruns DE, Goldstein DE, Maclaren NK, McDonald JM, Parrott M. Guidelines and recommendations for laboratory analysis in the diagnosis and management of diabetes mellitus. Clinical chemistry. 2002 Mar 1;48(3):436-72.
23. Masland RH. The fundamental plan of the retina. Nature neuroscience. 2001 Sep;4(9):877-86.
24. Diabetes Control and Complications Trial Research Group. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. New England journal of medicine. 1993 Sep 30;329(14):977-86.
25. Do DV, Shah SM, Sung JU, Haller JA, Nguyen QD. Persistent diabetic macular edema is associated with elevated hemoglobin Alc.Am J Ophthalmol. 2005 Apr:139(4):620-3
26. Stratton I.M et.al. Association of glycaemia with macrovascular and micro-vascular complications of type 2 diabetes (UKPDS 35): Prospective observational study. BMJ 2000, 321:405-412.