DOI: 10.7860/JCDR/2016/15834.7014

Original Article

Opthalmology Section

A Hospital Based Study Regarding Awareness of Association Between Glycosylated Haemoglobin and Severity of Diabetic Retinopathy in Type 2 Diabetic Individuals

MRIDULA PRABHU[1], ANUPAMA KAKHANDAKI[2], K.R. PRAVIN CHANDRA[3], M.B. DINESH[4]

ABSTRACT

Introduction: Diabetic retinopathy is one of the most common microvascular complications seen in diabetic patients after a long term of uncontrolled glycaemic status as assessed by glycosylated Haemoglobin A (HbA1c). Hence awareness of glycaemic control is necessary to prevent vision threatening complications.

Aim: To assess the awareness regarding association between glycosylated Haemoglobin (HbA1c) and diabetic retinopathy among diabetic patients and to assess the impact of lack of this knowledge on the severity of diabetic retinopathy (DR).

Materials and Methods: This hospital based cross-sectional study was conducted in the ophthalmology OPD on 200 adult diabetic patients, between November 2012 and January 2013, who were assessed for their knowledge regarding association between HbA1c and its impact on the progress of DR. The study was done with the help of a semi structured questionnaire which included demographic details, literacy levels, diabetic status and awareness of HbA1c.

Statistics Used: Cochran Armitage test for trend, Fisher Exact test, chi-square for trend and Student's t test.

Results: Among the 200 diabetic individuals attending our OPD, 180 (90%) were aware of the importance of blood sugar levels and its fluctuation in type 2 diabetes. Only 23 (11.5%) were aware of HbA1c whereas 10 (5%) misinterpreted it as levels of haemoglobin, 3 (1.5%) did not completely comprehend. About 164 (82%) patients were not aware of the significance or the terminology of HbA1c. Out of the 200 patients, 58 patients showed presence of some grade of DR. Amongst these 58 patients, 7(12.1%) were aware of HbA1c and all the11 patients with clinically significant macular oedema (CSME) were aware of the risk factors of elevated blood sugar levels but ignorant of HbA1c. Among the remaining 142 individuals who showed no signs of DR, 16 (27.5%) were aware of and comprehended the role of HbA1c.

Conclusion: Our study highlights the gross ignorance of role of HbA1c in the progress of DR among diabetic individuals. It is a known fact that the risk of DR reduces by 35% for every 1% reduction in HbA1c. Hence a strict control of blood sugar level with regular monitoring of HbA1c can help diabetic individuals in prevention of progress of DR, thus preventing severe vision loss.

Keywords: Blindness, Diabetes mellitus type 2, HbA1c, Vision loss

INTRODUCTION

Worldwide prevalence of diabetes is 180 million and is predicted to rise to 300 million by 2025 [1]. According to a prediction by WHO, India will lead in the number of adults with diabetes: from 19 million in 1995 to 80 million in 2030 [2]. Worldwide prevalence of DR is 26-52% whereas in India it is about 34% [3]. Blindness from any cause is a worldwide concern and DR is a well known frequent cause of visual impairment and irreversible visual loss. It is known to silently affect the middle age over a period of years to decades with symptoms occurring only very late in the disease. Therefore early detection and treatment of DR is of utmost importance for prevention of visual impairment and progression of DR.

HbA1c has been recommended for the diagnosis of diabetes by ADA (American diabetic association) with a target HbA1c level of <7%, as raised blood sugar level is a known modifiable risk factor in reducing the incidence and progression of DR [4,5]. We aim to assess, amongst adult diabetic individuals attending a tertiary hospital, regarding their knowledge of HbA1c and its relation to progress of DR.

MATERIALS AND METHODS

A hospital based cross sectional study was conducted on 200 adult patients diagnosed with type 2 diabetes mellitus, attending ophthalmology outpatient department of SDM Medical College, conducted between November 2012 and January 2013. A sample size of 200 was calculated based on 32% prevalence of diabetic retinopathy in the population above 30 years with an alpha error of 5 % and a precision level of 20%.

Study participants were defined as all patients above 18 years giving history of type 2 diabetes mellitus, attending ophthalmology outpatient department of SDM medical college on Tuesday, Thursday and Saturday which happened to be the outpatient days allotted to the investigator. Written, informed consent was obtained from all subjects and the study was performed in accordance with the tenets of the Declaration of Helsinki 2013. The Institutional ethical committee clearance was accorded from SDM College of Medical Sciences and Hospital.

Inclusion Criteria

1. Age of the subjects must be above 18 years.
2. Previously diagnosed with Diabetes Mellitus, type 2.
3. Willing to give informed consent for the study.

Exclusion Criteria

1. Age of the subjects below 18 years.
2. Patient attendees.
3. Subjects who were not willing to give informed consent for the study.

STUDY METHODOLOGY

A brief structured open-ended questionnaire concerning blood glucose and HbA1c was designed to record information about the subject's awareness about metabolic control (annexure 1). The questionnaire was initially developed in English and all the questions were translated into the two most common languages, Kannada and Hindi, if the subjects could not follow English. The questionnaire was interviewer – administered and done by a single investigator. Patients who stated that they understood HbA1c had to correctly define it as a measure of an individual's glycaemic control over the preceding two to three months. The grading of DR was based on the clinical examination done by the treating ophthalmologist at the time of examination.

RESULTS

Responses from the 200 patients included in this study were collected. It was observed that the age distribution of diabetics was predominantly from 40 to 70 years. It peaked at 60 – 70 years (37.5%) and did not differ across the genders. The mean age was 57.1 years and 124 (62%) were males. About 137 (68.5%) individuals resided in urban areas and 183 (91.5%) were Hindu by religion, 136 (68%) were literates. [Table/Fig-1] shows demographic details, literacy levels, diabetic duration, family history of diabetes, diabetic retinopathy status of all 200 subjects.

180 (90%) patients out of 200 who were a part of the study were aware of the importance of blood sugar levels and its fluctuations in Diabetes Mellitus. The determinants of blood sugar knowledge were duration of diabetes and family history. The knowledge of high blood sugar being the hallmark of diabetes was known to less than 86% of cases who had less than 5 years of diabetic duration. The knowledge was found to be more than 94% in those with more than 5 years duration of diabetes (p=0.05). This knowledge level increased as the duration of diabetes increased. This trend is increase in the ascending ordered categories of durations was significant by the

Total Subjects	200
Mean Age	57.19 Years
Gender(Nos) Men	124 (62%)
Women	76 (38%)
Residence (Nos) Urban	137 (68.5%)
Rural	63 (31.5%)
Literacy Literate	138 (68%)
Primary	18 (9%)
Secondary	57 (28.5%)
Post Secondary	61(30.5%)
Illiterate	64 (32%)
Duration of DM	Nos
<5	100 (50%)
5-10	62 (31%)
10-15	18 (9%)
15-20	12 (6%)
>20	8 (4%)
Hypertension	58 (29%)
Family h/o of DM	43 (21.5%)
Diabetic Retinopathy: Severity	
No DR	142 (71%)
NPDR	47 (23.5%)
PDR	9 (4.5%)
CSME	11 (5.5%)
Age of Retinopathy Cases	59.9 YeaRs
Retinopathy Cases Were Older	59 Versus 56 Years, p=0.01

[Table/Fig-1]: Demographic and literacy profiles of subjects

Duration of diabetes	Aware of Blood sugar importance (numbers)	Percentage %	Not aware of blood sugar importance (numbers)	Percentage %
< 5 years	86	86 %	14	14%
5-10 years	57	91.9%	5	8%
10-15 years	17	94.4%	1	5.1%
15-20 years	12	100%	0	0 %
>20 years	8	100%	0	0 %
	180	90%	20	100%

[Table/Fig-2]: Awareness of blood sugar showing increasing trend with duration of diabetes.
Cochran Armitage test for trend p=0.035< 0.05

	Number of subjects Total-200	Percentage %
Knowledge of HbA1c	23	11.5%
Mistook as Haemoglobin	10	5%
Not sure	3	1.5%
Did not understand	164	82%

[Table/Fig-3]: Subjects' awareness regarding glycosylated Haemoglobin A

Total Subjects	23/200 (11.5%)
Gender(Nos) Men	17/23 (73.9%)
Women	6/23 (26.1%)
Residence (Nos) Urban	20/23 (86.9%)
Rural	3/23 (13.1%)
Literacy Literate(Total)	20/23 (86.9%)
Post Secondary	10/23 (43.5%)
Secondary	8/23 (34.8%)
Primary	2/23 (08.7%)
Illiterate	3/23 (13.1%)
Literacy Related To Knowledge Of HbA1c	Chi-Square For Trend=33.23, p<0.001
Duration of DM	Nos
<5	13/23 (51.5%)
5-10	5/23 (21.7%)
10-15	1/23 (4.3%)
15-20	3/23 (13.1%)
>20	1/23 (4.3%)
Hypertension	7/23 (33.4%)
Family h/o of DM	3/23 (13.1%)
Diabetic Retinopathy: Severity	
No DR	16/23 (69.6%)
NPDR	6/23 (26.1%)
PDR	1/23 (4.3%)

[Table/Fig-4]: Details of participants who were aware of HbA1c

Cochran Armitage test for trend (p<0.05) as shown in [Table/Fig-2]. Knowledge regarding importance of blood sugar level control in diabetes could be predicted in those with positive family history (p< 0.05 by Fisher-Exact test).

[Table/Fig-3] shows awareness of HbA1c. A total of 164 (82%) were not aware of the significance or even the terminology of HbA1c, 23 (11.5%) patients were aware of HbA1c while 10 (5%) misinterpreted it as levels of Haemoglobin, 3 (1.5%) did not completely comprehend. The awareness of HbA1c test was present among those who were basically aware of blood sugar knowledge (23/180=12.77%). The remaining 20 who were unaware of blood sugar knowledge were also unaware of HbA1c.

Among the 200 patients included in this study, 58 had some grade of diabetic retinopathy. Seven (12.5%) out of these were aware of HbA1c. Out of the remaining 142 patients who did not demonstrate

any of the changes pertaining to DR, 16 (27.5%) were aware and comprehended the role of HbA1c. This shows that the cases of diabetic retinopathy had a very low proportion of correct awareness of HbA1c. This ought to be nearly 100%, and indicates gross ignorance and huge demand for health education.

Among 11 patients who showed the presence of clinically significant macular oedema, all were aware of the risk factors of elevated blood sugar levels but ignorant of HbA1c levels.

Of the 200 patients, 142 (71%) had no DR, 47(23.5%) had non proliferative diabetic retinopathy (NPDR), 9 (4.5%) had proliferative diabetic retinopathy (PDR) and 11(5.5%) had clinically significant macular oedema (CSME). Diabetic retinopathy cases were older than diabetics without retinopathy: 59.9 versus 56 years respectively, p= 0.01. Out of these 58 subjects who had diabetic retinopathy, 26 subjects had duration of diabetes ranging between 5 to 10 years, 10 subjects had duration of < 5 years, 9 subjects had duration between 15 to 20 years and 5 had duration more than 20 years.

The characteristics of subjects who had knowledge of HbA1c is given in [Table/Fig-4].

The determinant of knowledge of HbA1c was literacy level. Literacy was significantly associated with awareness of HbA1c. ($p< 0.05$). HbA1c awareness increased as the literacy level increased, chi-square for trend = 33.23, $p<0.001$. HbA1c was not associated with any of the 8 demographic variables namely age group, gender, residence, duration of diabetes, family history of diabetes, co-morbid hypertension, diabetic retinopathy occurrence and source of awareness.

DISCUSSION

Various studies have confirmed the findings that hyperglycaemia is associated with the progression of DR [6]. HbA1c is a good indicator of glycaemic control over the last few months. Hence regular HbA1c levels can help diabetic individuals to monitor their glycaemic control effectively and help in prevention of worsening of microvascular abnormalities such as DR. Regarding the awareness of blood sugar levels, our study was similar to the study done by You Chuen Chin with respect to higher literacy levels and the absence of gender bias but was dissimilar with regard to duration of diabetes [1].

In our study HbA1c awareness was not associated with any significant probability with regard to age, gender, residence, duration of diabetes, family history, co-morbid hypertension. However according to the study done by Srinivasan Sanjay et al., and Wang S et al., increased awareness was associated with younger age group [4,7]. Our study showed increased awareness with higher levels of literacy which was similar to studies done by Srinivasan Sanjay et al., Wang S et al., Annunziata K et al., and You Chen Chin et al., [1,4,7,8].

According to study done by Annunziata K et al., in Brazil in the year 2012, the lack of awareness of HbA1c levels suggests a significant gap inpatient education. Improvement in access and education may help improve overall type 2 diabetes management [8].

A similar study performed at a tertiary ophthalmic centre in Singapore in the year 2013 by Srinivasan Sanjay et al., concluded that there was greater awareness of HbA1c among the younger age groups and those with higher education levels [7]. Similarly in our study literacy was significantly associated with awareness of HbA1c ($p<0.05$).

Severity of progression from NPDR to PDR with respect to HbA1c values were studied by many authors and several studies such as Advanced glycation index and its association with severity of diabetic retinopathy in type 2 diabetic subjects by Anitha B et al., in the year 2008 as well as similar studies by Rani PK et al., in the year 2009 and the CURES study performed by Pradeepa R et al., in 2008 in Chennai were in accord and point out to the proof that poor control of sugars and elevated glycaemic index resulted in worsening of Diabetic Retinopathy and was associated with a transition from non proliferative diabetic retinopathy (NPDR) to proliferative diabetic retinopathy (PDR) [9-11].

A population based study in Chennai performed in the year 2011 by Rajiv Raman et al., concluded that subjects with diabetes with HbA1c >8% would give maximum yield of sight-threatening-retinopathies [12].

The major setback for improving knowledge regarding diabetes mellitus, DR and its correlation with HbA1c is lack of awareness. A diabetic individual can be made motivated to keep his or her HbA1c levels below 7% provided he/she becomes aware of its direct correlation with blood sugar levels. Most diabetics aim at reducing the blood sugar levels following occasional spurts of elevated blood sugar levels due to various reasons such as festivals, illness, stress etc. However they fail to understand the ill effects of fluctuating blood sugar levels on DR. Once they are made to understand the importance of maintaining a uniform level of blood sugar within normal limits, they can be educated about how HbA1c levels reflect the above. Thus they can be motivated to keep their HbA1c levels below 7% which would in turn help to prevent the progress of DR and its dreaded complications causing irreversible visual loss.

LIMITATION

The limitation of the present study was that it was a hospital based study which cannot be extrapolated to community population.

Author	Year	Country	Study Population	Awareness of HbA1c
Diana V et al., [5]	2005	Singapore	Tertiary centre	51% understood, 17% not sure, 33% did not understand
Wang S et al., [4]	2008	Australia	Tertiary centre	49% heard, 17% understood
Annunziata K et al., [8]	2012	Brazil	Population based	85.5% did not know their HbA1c levels
Sanjay S et al., [7]	2013	Singapore	Tertiary centre	Higher education, younger age, longer duration of diabetes-greater HbA_{1c} awareness. Exact value not mentioned.
Present study	2013	India	Tertiary centre	11.5% aware

[Table/Fig-5]: Comparison with other studies

[Table/Fig-5] shows comparison with other studies. In a study done by Diana V et al., in Singapore in 2005, only half of diabetic patients surveyed understood the concept of HbA1c, in spite of all of them having some grade of DR [5]. In our study only 23(11.5%) patients were aware of HbA1c.

According to study by Wang S et al., less than half of participants had heard of HbA1c and 17% had actually understood it which was more than in the present study [4].

CONCLUSION

To conclude, the awareness regarding the relationship between HbA1c and DR among diabetics is very low in our study. Previous studies have shown that proper education in this regard brought the HbA1c value down from 8.5% to 7.8%. A good knowledge of control of HbA1c levels is very important to prevent the progress of DR and its vision-threatening complications. This stresses the importance of health education to all diabetics and thus helps in better diabetes management and prevention of its complications.

REFERENCES

[1] Chin YC, Sanjay S, Ong EL, Sun Y, Au Eong KG. Periodic blood glucose test and its relationship with diabetic retinopathy among patients with diabetes in a tertiary ophthalmic centre. *Ophthalmic research: An international journal.* 2013;1(1):23-30.

[2] Rani PK, Raman R, Agarwal S, Paul PG, Uthra S, Margabandhu G. et al. Diabetic retinopathy screening model for rural population: awareness and screening methodology. *Rural Remote Health.* 2005;5(4):350.

[3] Dandona L, Dandona R, Naduvilath TJ, McCarty CA, Rao GN. Population based assessment of diabetic retinopathy in an urban population in Southern India. *Br J Ophthalmol.* 1999;83:937–40.

[4] Wang S, Tikellis G, Wong N, Wong TY, Wang JJ. Lack of knowledge of glycosylated Haemoglobin in patients with diabetic retinopathy. *Diabetes Res Clin Pract.* 2008;81:e15–17.

[5] Do DV, Nguyen QD, Bressler NM, Schachat AP, Solomon SD, Melia M, et al. Haemoglobin A1c awareness among patients receiving eye care at a tertiary ophthalmic center. *Am J Ophthalmol.* 2006;141(5):951-53.

[6] Hou JN,Bi YF, Xu M, Huang Y, Li XY, Wang WQ, et al. The change points of HbA (1C) for detection of retinopathy in Chinese type 2 diabetic patients. *Diabetes Res Clin Pract.* 2011;91(3):401-05.

[7] Sanjay S, Chin YC, Sun Y, Ong EL, Au Eong KG. Awareness of HbA 1c and Its Relationship With Diabetic Retinopathy Among Adult Diabetic Patients Attending a Tertiary Ophthalmic Center. *Diabetes Care.* 2013;36(1):1–3.

[8] Annunziata K, Pomerantz D, DiBonaventura M, Follador W. Patient access, Hba1c knowledge, and health outcomes among type 2 diabetes patients in Brazil. *Kantar Heal.* 2012;32:8540.

[9] Anitha B, Sampathkumar R, BalasubramanyamM, Rema M. Advanced glycation index and its association with severity of diabetic retinopathy in type 2 diabetic subjects. *J Diabet Complications.* 2008;22:261–66.

[10] Rani PK, Raman R, Chandrakantan A, Pal SS, Perumal GM, Sharma T. Risk factors for diabetic retinopathy in a self reported rural population with diabetes. *J Postgrad Med.* 2009;55:92–96.

[11] Pradeepa R, Aneetha B, Mohan V, Ganesan A, Rema M. Risk factors for diabetic retinopathy in a South Indian Type 2 diabetic population – the Chennai Urban Rural Epidemiology Study (CURES) Eye Study 4. *Diabetes Med.* 2008;25:536–42.

[12] Raman R, Verma A, Pal SS, Gupta A, Vaitheeswaran K, Sharma T. Influence of glycosylated Haemoglobin on sight-threatening diabetic retinopathy: a population-based study. *Diabetes Res Clin Pract.* 2011;92(2):168-73.

PARTICULARS OF CONTRIBUTORS:

1. Associate Professor, Department of Ophthalmology, S D M College of Medical Sciences and Hospital, Sattur, Dharwad, India.
2. Professor, Department of Ophthalmology, S D M College of Medical Sciences and Hospital, Sattur, Dharwad, India.
3. Associate Professor, Department of Community Medicine, S D M College of Medical Sciences and Hospital, Sattur, Dharwad, India.
4. Postgraduate, Department of Ophthalmology, S D M College of Medical Sciences and Hospital, Sattur, Dharwad, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Mridula Prabhu,
Associate Professor, Department of Ophthalmology, S D M College of Medical Sciences and Hospital,
Sattur, Dharwad-580009, India.
E-mail: mridulaprabhu@rediffmail.com

FINANCIAL OR OTHER COMPETING INTERESTS: None.

Date of Submission: **Jul 21, 2015**
Date of Peer Review: **Oct 16, 2015**
Date of Acceptance: **Nov 02, 2015**
Date of Publishing: **Jan 01, 2016**