Correlation between HbA1c and Diabetic Retinopathy in Type 2 Diabetes Mellitus

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ABSTRACT

BACKGROUND

Type 2 diabetes mellitus is now a common and a global health problem in both developed and developing country due to dietary change, reduced physical activities, increase urbanisation, increasing age and unhealthy life style. Risk of diabetic retinopathy increases with increase in duration and severity of hyperglycaemia. HbA1c is the important predictor for treatment and risk of developing microvascular and macrovascular complications. So, correlation between HbA1c and diabetic retinopathy in type 2 diabetes mellitus is depicted in our study. We wanted to study the relationship between HbA1c and diabetic retinopathy in type 2 diabetes mellitus and correlate the severity of diabetic retinopathy with increase in levels of HbA1c.

METHODS

It is an observational study done in tertiary care hospital from September 2018 to August 2019. 200 patients who were referred from endocrinology department for funduscopic examination having complaints of vision loss were enrolled in the study. Age, sex, duration of diabetes, FBS, PPBS, HbA1c value, and funduscopy findings were recorded. Patients were followed up for 3 months.

RESULTS

200 patients were included in the study. 115 (57.5%) were male, 85 (42.5%) were female. Male:Female ratio was 1.35:1.80 (40%), had HbA1c value >14.5; 50 (25%) patients had 12.6-14.5; 38 (19%) patients had 10.6-12.5; 22 (11%) patients had 8.6-10.5; and 10 (5%) patients had 7-8.5.

CONCLUSIONS

Severity of diabetic retinopathy increases in patients with higher value of HbA1c. HbA1c is the predictor of severity of diabetic retinopathy.

KEYWORDS

HbA1c, Diabetic Retinopathy, Type 2 Diabetes Mellitus

BACKGROUND

Diabetes mellitus is a chronic condition that affects the body as the blood glucose level increases. Diabetes is a metabolic disease which is characterized by hyperglycaemia due to decrease in either insulin secretion, insulin action or both.[1] Type 2 diabetes mellitus is more common than type 1 diabetes and it occurs in nearly 90% of population of diabetes.[2] Type 2 diabetes mellitus usually affects middle aged people and also affect young age.[3] Diabetic retinopathy develop as early as or before 7 years of diagnosis of diabetic mellitus type 2. Type 2 diabetes mellitus is now common and global health problem in both developed and developing countries due to increase in dietary change, reduced physical activities, increase urbanisation, increased age and unhealthy life style. Previously, diagnostic criteria of diabetes mellitus was fasting blood sugar (FBS) and 2 hour post prandial blood sugar (PPBS). Standard FBS value for diabetes mellitus is ≥126 mg/dl and PPBS value ≥200 mg/dl. Glycated haemoglobin A1c (HbA1c) was recommended by world health organisation (WHO) for diagnosing diabetes. Glycated haemoglobin occurs when a type of protein called haemoglobin which is present in red blood cells carries oxygen in all over the body and along with blood become glycated. HbA1c value tells about patient's average level of blood sugar over past 2 to 3 months. Complication of diabetes has both microvascular and macrovascular diseases, ischaemic heart diseases and cerebrovascular diseases which leads to tissue and organ damage. Diabetic retinopathy is one of the most common microvascular complication along with diabetic nephropathy and diabetic neuropathy. Diabetic retinopathy is a chronic sight threatening disease caused by progressive uncontrolled hyperglycaemia. Diabetic retinopathy is the important cause of visual loss in working age people. Diabetic retinopathy in type 2 diabetes mellitus is one of the fast growing and leading cause of blindness in global health problem. About 2.5 million people are blind due to diabetic retinopathy in developed country. Good blood sugar control reduces the risk of progression of diabetic retinopathy. It is one of the leading cause of blindness among individual between 25-74 years of age.[4] It affects 3 out of 4 diabetic patients after 15 years of disease duration. Loss of pericytes is one of the earliest and most specific sign of diabetic retinopathy. This finding was described by Cogan, Kuabara and co-worker after examining trypsin digested retinal vasculature flat mounts from diabetic human subjects.[4] Risk of diabetic retinopathy increases with increase in duration and severity of hyperglycaemia. ETDRS (Early Treatment of Diabetic Retinopathy Study) also supported that good glycaemic control is important in early stage of diabetes as it delay onset of diabetic retinopathy. It is the most common complication of type 2 diabetes mellitus. Many studies and author encourage strict glycaemic control to prevent early onset of diabetic retinopathy. HbA1c is the important predictor for treatment and risk of developing microvascular and macrovascular complication. So, correlation between HbA1c and diabetic retinopathy in type 2 diabetes mellitus is depicted in our study.

We wanted to study the relationship between HbA1c and diabetic retinopathy in type 2 diabetes mellitus and correlate the severity of diabetic retinopathy with increase in level of HbA1c.

METHODS

It is an observational study done in tertiary care hospital from September 2018 to August 2019. 200 patients were taken who were referred from endocrinology department for funduscopic examination having complain of vision loss. Age, sex, duration of diabetes, FBS, PPBS, HbA1c value, and funduscopy findings were recorded.

Inclusion Criteria
Patients of type 2 diabetes mellitus who were referred from endocrinology department for funduscopic examination and having complain of visual loss.

Exclusion Criteria
- Diabetic cataract.
- Gestational diabetes patients.
- Type 1 diabetes mellitus patient.
- Acute and chronic renal failure.
- Congestive heart failure patients.
- Patients with hazy media due to dense cataract or any corneal opacity.
- Hypertensive patients.

200 patients were taken in our study who were referred from endocrinology department for funduscopic examination who were having complain of vision loss. Detailed medical history taken with ocular symptoms. In history particularly duration of diabetes was taken carefully. History of use of oral anti hyperglycaemic drugs or insulin was taken. Any other history like hypertension or any heart disease was taken. Local and systemic examination were done along with ocular examination Visual acuity done by Snellen's chart was recorded. Best corrected visual acuity was also recorded. Anterior segment evaluation was done with slit lamp biomicroscopy, 90 D evaluation was done. Funduscopy was done and funduscopic photography was taken with the help of ZEISS CLARUS 500 fundus camera. All patients underwent blood test like complete blood count, FBS, PPBS, HbA1c test, renal function test, lipid profile test. Patients were followed up up to 3 months. Grading of diabetes was done as per Early Treatment Diabetic Retinopathy Study (ETDRS). Non-proliferative diabetic retinopathy (NPDR).

Non-Proliferative Diabetic Retinopathy (NPDR)[5]
1. No DR
2. Very mild NPDR- Microaneurysms only.
3. Mild NPDR- Any or all of: microaneurysms, retinal haemorrhages, exudates, cotton wool spots, up to the

level of moderate NPDR. No intraretinal microvascular anomalies (IRMA) or significant beading.

4. Moderate NPDR

- Severe retinal haemorrhages (more than ETDRS standard photograph 2A: about 20 medium–large per quadrant) in 1–3 quadrants or mild IRMA.
- Significant venous beading can be present in no more than 1 quadrant.
- Cotton wool spots commonly present.
  ➢ Severe NPDR

5. Severe NPDR

The 4–2–1 rule; one or more of:

- Severe haemorrhages in all 4 quadrants.
- Significant venous beading in 2 or more quadrants.
- Moderate IRMA in 1 or more quadrants.

6. Very Severe NPDR

Two or more of the criteria for severe NPDR

Proliferative Diabetic Retinopathy

1. Mild – Moderate PDR-
New vessels on the disc (NVD) or new vessels elsewhere (NVE), but extent insufficient to meet the high-risk.

2. High Risk PDR

- New vessels on the disc (NVD) greater than ETDRS standard photograph 10A (about 1/3 disc area).
- Any NVD with vitreous haemorrhage.
- NVE greater than 1/2 disc area with vitreous haemorrhage.

RESULTS

200 patients were included in this study.

Sex	Number of Cases	%
Male	115	57.5%
Female	85	42.5%
Table 1. Sex Distribution of Patients

Age	Number of Patients	%
20-40 years	37	18.5
41-60 years	79	39.5
61-80 years	63	31.5
>80 years	21	10.5
Table 2. Age Distribution of Patients

From the above table it can be seen that of 200 patients, most of the patients were from age group 41-60 years of age and of 79 (39.5%), 63 (31.5%) patients were from age group 61-80 years, 37 (18.5%) patients were from age groups 20-40 years of age.

Prevalence	No. of Patients	%
Mild NPDR	35	17.5
Moderate NPDR	40	20
Severe NPDR	90	45
Early PDR	25	12.5
High risk PDR	10	5
Table 3. Prevalence of Diabetic Retinopathy

From the above table it can be seen that of 200 patients most of the patients 90 (45%) were having severe NPDR, 40 (20%) patients had moderate NPDR, 35 (17.5%) patients had mild NPDR, 25 (12.5%) patients had early PDR, 10 (5%) patients had high risk PDR.

Duration	Mild NPDR	Moderate NPDR	Severe NPDR	Early PDR	High Risk PDR	Total
<10 years	5	5	15	2	1	28 (14%)
10-20 years	10	10	25	5	2	52 (26%)
20-40 years	20	25	50	18	7	120 (60%)
Table 4. Duration of Type 2 Diabetes Mellitus with Severity Diabetic Retinopathy

From the above table it was revealed that most of the patients 120 (60%) were between diabetes mellitus duration 20-40 years of age, 52 (26%) patients were between duration of 10-20 years, 28 (14%) patients were between duration of <10 years. This shows as duration of diseases increases severity of diabetic retinopathy increases.

HbA1c	Mild NPDR	Moderate NPDR	Severe NPDR	Early PDR	High Risk PDR	Total
7-8.5	2	3	3	1	1	10 (5%)
8.6-10.5	5	4	9	3	1	22 (11%)
10.6-12.5	8	7	16	5	2	38 (19%)
12.6-14.5	9	11	22	6	2	50 (25%)
>14.5	11	15	40	10	4	80 (40%)
Total	35	40	90	25	10	200 (100%)
Table 5. Relationship Between Value of HbA1c and Severity of Diabetic Retinopathy

From the above table it can be seen that most of the patients 80 (40%) were in between HbA1c value >14.5, 50 (25%) patients were in between 12.6-14.5, 38 (19%) patients were in between 10.6-12.5, 22 (11%) were between 8.6-10.5, and 10 (5%) were in between 7-8.5. This table shows as value of HbA1c increases severity of diabetic retinopathy increases.

DISCUSSION

Basically, diabetic retinopathy is a microvascular complication of diabetic mellitus, which occurs due to poor glycaemic control. The increase in prevalence of diabetes and its complication become a great health concern to health care provider all over the world. Table 1 males were 115 (57.5%) and females were 85 (42.5%). Male: Female ratio was 1.35:1. This was correlating with the study done by Niveditha H et al, and Gadkari SS et al. Prevalence of diabetic retinopathy varies worldwide.[6,7] According to blue eye mountain study prevalence is 29% and according to Wisconsin epidemiological study it is 50.3%.[8,9] According to CURES (Chennai Urban Rural Epidemiological Study) prevalence of diabetic retinopathy is 17.6%.[10] Table 2 shows most of the patients were from age group 41-60 years of age and of 79 (39.5%), 63 (31.5%) patients were from age group 61-80 years, 37 (18.5%) patients were from age groups 20-40 years of age. This shows prevalence of diabetes mellitus and diabetic retinopathy is more in middle age groups i.e., 41-60 years. Table -3 shows most of the

patients 90 (45%) were having severe NPDR, 40 (20%) patients had moderate NPDR, 35 (17.5%) patients had mild NPDR, 25 (12.5%) patients had early PDR, 10 (5%) patients had high risk PDR. This is in accordance with the study done by Dr. Rajendra Prasad, Dr. Nayana.[11] Table 4 shows most of the patients 120 (60%) were between diabetes mellitus duration 20-40 years of age, 52 (26%) patients were between duration of 10-20 years, 28 (14%) patients were between duration of <10 years. This shows that as the duration of diseases increases severity of diabetic retinopathy increases. Severity of diabetic retinopathy increases with decrease in glycaemic control.

According to CURES Eye study as level HbA1c increases by 2%, risk of diabetic retinopathy increases by 1.7.[12,13] Table 5 shows most of the patients 80 (40%) were in between HbA1c value >14.5,50 (25%) patients were in between 12.6-14.5, 38 (19%) patients were in between 10.6-12.5, 22 (11%) were between 8.6-10.5, and 10 (5%) were in between 7-8.5. This table shows as value of HbA1c increases severity of diabetic retinopathy increases. Yun et al studied the association between diabetic retinopathy and HbA1c, which shows diabetic retinopathy was more in patients having HbA1c value.[14] Our study also supports this.

Our study showed that majority of patients 80 (40%) were from HbA1c value more than >14.5 which reflects poor glycaemic control. Based on our findings urgent medical attention was given for strict glycaemic control. Patients have to be educated regarding screening of HbA1c, as patients have least knowledge regarding HbA1c test. Patients were advised to encourage regular exercise, life style modification and dietary changes. As from our study it can be seen that HbA1c is strong predictor of occurrence of severity of diabetic retinopathy, so treating physicians should persuade screening test of HbA1c for all diabetic patients and patients with higher level of HbA1c value should be referred to ophthalmologist as soon as they are diagnosed. So here both general physicians and ophthalmologist play important role in educating about diabetes mellitus, diabetic retinopathy and role of HbA1c screening test. Patients should be educated regarding diabetic diet which lowers HbA1c level.

Limitations

Limitation of our study period was short (1 year) and follow up is also short i.e. 3 months, so if study period will long then we can compare the study done by Leske et al,[15] in Barbodose eye study, they found that every 1% increase in HbA1c from baseline was associated with a >2-fold risk of DR, up to 4 years of follow up.

CONCLUSIONS

Severity of diabetic retinopathy increases in patients with higher value of HbA1c. HbA1c is a strong predictor of severity of diabetic retinopathy. So, it is important to do HbA1c test as a screening test in every type 2 diabetes mellitus patient, so that early diagnosis of severity of diabetic retinopathy can be done and patients can be encouraged to start treatment in early stages so that diabetic retinopathy can be prevented.

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