International Journal of Research in Medical Sciences
Noticewala V et al. Int J Res Med Sci. 2017 Nov;5(11):4840-4845
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20174930

Original Research Article

A study of contrast sensitivity changes in normal individual and diabetic patients with and without diabetic retinopathy

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Received: 21 August 2017
Accepted: 20 September 2017

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ABSTRACT

Background: To study contrast sensitivity changes in healthy individuals and in diabetic patients with and without diabetic retinopathy.
Methods: Study was conducted at tertiary care hospital, Surat. Contrast sensitivity functions were assessed with PELLI ROBSON CHART with help of electronic displays. Results were analyzed using chi square test.
Results: Total 114 patients were taken into study. Maximum patients were in age group 46-55 years. Mean age of diabetic individuals was 51 and in healthy individual mean age is 52. Total 18 patients with Diabetic retinopathy, among 57 diabetic patients were taken into study. Sex ratio in diabetic group is Male: Female 2.5:1 and healthy individual is Male: Female 2.1:1. There is significant reduction in contrast sensitivity function in subjects with diabetes as compared to healthy individuals. (P value<0.05) There is significant reduction in Visual Acuity (P value<0.05). There was significant association of high FBS and PP2BS level with diabetic retinopathy and contrast sensitivity, the contrast sensitivity function decreases as metabolic control of blood sugar level fluctuates. In present study, Duration of diabetes mellitus doesn't have significant association with contrast sensitivity function. (p value > 0.05) In present study, there isn't significant association of contrast sensitivity function and visual acuity with cataract, as above patients were having early or few cataract changes. (p value > 0.05). In present study, there isn't significant association between blood pressure control and contrast sensitivity function (p value > 0.05).
Conclusions: Majority of the subjects in the present study belonged to the age group 46-55 years (38.6%). Mean age of diabetic individuals was 51 and healthy individual mean age is 52. Total 18 patients with DR, among 57 diabetic patients were taken into study. Sex ratio (male: female) in diabetic group is 2.5:1 and healthy individual is 2.1:1. There is significant reduction in contrast sensitivity function in subjects with diabetes as compared to healthy individuals. (P value<0.05). So is with decimal equivalent VA and decimal equivalent BCVA. (Both P value<0.05). There is significant association between FBS and PP2BS level with contrast sensitivity, the contrast sensitivity function decreases as metabolic control of blood sugar level fluctuates. (P value< 0.05). There was significant association between high FBS level and diabetic retinopathy as well. (p value<0.05).

Keywords: Best corrected visual acuity, Fasting blood sugar level, Post prandial blood sugar level, Standard deviation

INTRODUCTION

Diabetic retinopathy is a common consequence of diabetes mellitus and the leading cause of vision loss in India which is now having epidemic of diabetes. The prevalence of diabetic retinopathy in Indian urban population with diabetes mellitus was found to be 18%.[1] The pathology of this disease is well characterized by

microvascular lesions but also includes deficits in visual function, possibly as a consequence of retinal neurodegeneration. Microvasculature changes are clinically detected by dilated fundus examination by seven field 30-degree stereo color fundus photographs as gold standard for diabetic screening and used as the primary method of diagnosis which is relatively expensive and difficult to obtain, but functional tests can be used as early markers of disease progression and end stage of loss of vision.[2] Components of visual function can be characterized in a variety of different ways including measures of acuity, contrast sensitivity, dark adaptation and a number of electrophysiological parameters of the retina. Present study is done to show whether contrast sensitivity can be used as an early index of changes in the retina in diabetics with and without background retinopathy.

A contrast sensitivity test measures your ability to distinguish between finer and finer increments of light versus dark (contrast). This differs from common visual acuity testing in a routine eye exam, which measures one's ability to recognize smaller and smaller letters on a standard eye chart. Contrast sensitivity is a very important measure of visual function, especially in situations of low light, fog or glare, when the contrast between objects and their background often is reduced. Driving at night is an example of an activity that requires good contrast sensitivity for safety. Even if one has 6/6 visual acuity, one can have eye or health conditions that may diminish his/her contrast sensitivity.

METHODS

Study was conducted at tertiary care hospital, Surat. Contrast sensitivity function was assessed with PELLI ROBSON CHART with help of electronic displays. Results were analyzed using chi square test.

Inclusion criteria

Patients having diabetes with and without diabetic retinopathy and healthy individuals more than 25 year of age attending the Ophthalmology OPD over the period February 2016-November 2017 were considered for the study.

The study subjects were divided into healthy individual and patients of Type 2 diabetes mellitus (with and without clinical evidence of diabetic retinopathy). 56 patients were enrolled in each of the above two groups after obtaining a written informed consent.

Exclusion criteria

The patients excluded from the study were any patients with history of recent ocular surgery or photocoagulation that could possibly interfere with the interpretation of study result; like contact lens wearers, patients having undergone LASIK surgery; patients with dense cataract or glaucoma; amblyopic patients, patients having ocular pathology including infection or trauma.

RESULTS

Contrast sensitivity function was assessed with PELLI ROBSON CHART with help of electronic displays. Study was analyzed using chi square test.

Table 1: Distribution of the subjects under study as per age.

Age in years	DM		Healthy	
	No.	%	No.	%
26-35	3	5.3	1	1.8
36-45	11	19.3	8	14.0
46-55	23	38.6	23	40.4
56-65	17	29.8	21	36.8
66-75	3	5.3	2	3.5
Total	57	100.0	57	100.0

Table 2: Distribution of the subjects under study as per sex.

	Diabetic		Healthy	
	Frequency	%	Frequency	%
Male	41	71.9	39	68.4
Female	16	28.1	18	31.6
Total	57	100.0	57	100.0

Table 3: CSF and age distribution pattern.

Age	CSF RE		CSF LE		CSF BE	
	Mean	SD	Mean	SD	Mean	SD
26-35	1.31	0.14	1.31	0.14	1.31	0.14
36-45	1.28	0.12	1.32	0.12	1.32	0.12
46-55	1.28	0.29	1.34	0.18	1.34	0.18
56-65	1.28	0.25	1.28	0.20	1.28	0.20
66-75	1.25	0.32	1.25	0.33	1.25	0.33
Total	1.29	0.30	1.31	0.30	1.31	0.30

P value > 0.05

Table 4: Sensitivity and specificity of contrast sensitivity function assessment with pelli robson chart with help of electronic displays.

	Right eye (%)	Left eye (%)	Both eye (%)
Sensitivity	71.93	75.44	75.44
Specificity	10.53	0.00	0.00
PPV	44.57	43	43
NPV	27.27	0.00	0.00

As per Table number 1, majority of the subjects in the present study belonged to the age group 46-55 years (38.6%). Mean age of diabetic individuals was 51.42 with SD 9.18 and healthy individual Mean age is 52.96 with SD 9.09. Total 18 patients with DR among 57 diabetic patients were taken into study.

Table 5: Contrast sensitivity and diabetes.

Diabetes	Contrast sensitivity					
	Right eye		Left eye		Both eye	
	Intact	Decreased	Intact	Decreased	Intact	Decreased
Present	00	57	00	57	02	55
Absent	51	06	57	00	57	00

Table 5: Contrast sensitivity and diabetes.

	Diabetes	N	Mean Contrast sensitivity	Std. deviation
Right eye	Present	57	1.10	0.29
	Absent	57	1.47	0.07
Left eye	Present	57	1.13	0.24
	Absent	57	1.50	0.00
Both eye	Present	57	1.19	0.20
	Absent	57	1.50	0.00

P value > 0.05

As per Table 2, there are total 34 females and 80 males taken into study. Sex ratio in diabetic group is (Male: Female) 2.5:1 and healthy individual is (Male: Female) 2.1:1.

Table 7: Decimal equivalent VA in patients with and without diabetic retinopathy.

	Diabetes	N	Mean Decimal equivalent VA	Std. Deviation
Right eye	Present	57	0.30	0.31
	Absent	57	0.21	0.17
Left eye	Present	57	0.26	0.20
	Absent	57	0.15	0.09

P value < 0.05

As per table no.3, there isn't significant correlation between Age and Contrast Sensitivity Function in present study. As per Table 4, 5, 6.

- Mean CSF of Right Eye of subjects with diabetes was 1.10 and with healthy individual was 1.47,
- Mean CSF of Left Eye of subjects with diabetes was 1.13 and with healthy individual was 1.50,
- Mean CSF of Both Eyes of subjects with diabetes was 1.19 and with healthy individual was 1.50,
- Binocular CSF is more than that of uniocular CSF,
- Graph showing analysis of CSF with diabetic and healthy individuals which shows p value to be less than 0.05 in all groups which leads us to the observation that significant difference exists while comparing CSF in both age group, and there is significant reduction in CSF in subjects with diabetes as compared to healthy individuals. This justifies our study and rejects null hypothesis.

Table 8: Decimal equivalent BCVA in patients with and without diabetic retinopathy.

	Diabetes	N	Mean Logmar BCVA	Std. Deviation
Right eye	Present	57	0.15	0.13
	Absent	57	0.07	0.08
Left eye	Present	57	0.14	0.13
	Absent	57	0.05	0.08

Table 9: Patients characteristics.

	Diabetic retino-pathy	N	Mean	SD	P value
FBS	Present	19	158.63	17.22	0.0134
	Absent	95	113.66	22.09	
Pp2bs	Present	19	265.21	12.06	0.0004
	Absent	95	179.82	60.97	
Systolic	Present	19	149.15	8.11	0.8000
	Absent	95	149.62	7.54	
Diastolic	Present	19	83.89	1.82	0.8400
	Absent	95	84.00	3.26	

Table 10: FBS and contrast sensitivity.

FBS	Contrast sensitivity					
	Right eye		Left eye		Both eye	
	Intact	Decreased	Intact	Decreased	Intact	Decreased
>125	0	54	0	54	2	52
<125	51	9	57	3	57	2

Table 11: PP2BS and contrast sensitivity.

PP2BS	Contrast sensitivity					
	Right eye		Left eye		Both eye	
	Intact	Decreased	Intact	Decreased	Intact	Decreased
>200	0	57	0	57	2	55
<200	51	6	57	0	57	0

P value < 0.05

Table 12: Duration of diabetes and CSF.

Contrast sensitivity	Duration	N	Mean	SD
Re	<5 years	107	1.49	0.06
	>5 years	7	1.50	0.00
Le	<5 years	107	1.50	0.00
	>5 years	7	1.50	0.00
Be	<5 years	107	1.50	0.00
	>5 years	7	1.50	0.00

Table 13: CSF and blood pressure.

BP	Contrast sensitivity					
	Right eye		Left eye		Both eye	
	Intact	Decreased	Intact	Decreased	Intact	Decreased
<120/80	1	3	2	2	2	2
>120/80	50	60	55	55	57	53

Table 14: Decimal equivalent VA in patients with and without cataract.

	Cataract	N	Mean Decimal equivalent VA	Std. Deviation
Right eye	Present	77	0.29	0.27
	Absent	37	0.20	0.20
Left eye	Present	77	0.20	0.14
	Absent	37	0.22	0.20

Table 15: CSF and cataract.

	Cataract	N	Mean Contrast sensitivity	Std. deviation
Right eye	Present	77	1.29	0.28
	Absent	37	1.27	0.28
Left eye	Present	77	1.31	0.28
	Absent	37	1.32	0.15
Both eye	Present	77	1.35	0.24
	Absent	37	1.34	0.12

Mean decimal equivalent VA of Right Eye of subjects with diabetes was 0.30 (6/12) and with healthy individual was 0.21 (6/9), Mean decimal equivalent VA of Left Eye of subjects with diabetes was 0.26 (6/9P) and with healthy individual was 0.15 (6/9), P value is less than 0.05 which suggests that there is significant reduction in decimal equivalent VA in subjects with diabetes (As shown in Table7).

Mean decimal equivalent BCVA of Right Eye of subjects with diabetes was 0.15 (6/9) and with healthy individual was 0.07 (6/6P),

Mean decimal equivalent BCVA of Left Eye of subjects with diabetes was 0.14 (6/9) and with healthy individual was 0.05 (6/6P),

P value is less than 0.05 which suggests that there is significant reduction in decimal equivalent BCVA in subjects with diabetes (As shown in table no.8).

- Mean FBS among diabetic retinopathy patients was 158.63 and patients without diabetic retinopathy was 113.66 here p value was <0.05, which is suggestive of significant association between high FBS level and diabetic retinopathy,
- Mean PP2BS among diabetic retinopathy patients was 265.21 and patients without diabetic retinopathy was 179.82 here p value was <0.05 which is suggestive of significant association between high PP2BS level and diabetic retinopathy,
- Mean Systolic BP was ˜ 150 and diastolic BP was ~ 84 with p value > 0.05 which shows there isn't significant

association between two variables in present study (As shown in Table 9).

Here, p value is less than 0.05, which shows significant association between FBS level and contrast sensitivity, the CSF decreases as metabolic control of blood sugar level fluctuates (As shown in Table 10).

Here, p value is less than 0.05, which shows significant association between PP2BS level and contrast sensitivity, the CSF decreases as metabolic control of blood sugar level fluctuates (As shown in Table 11).

Here, P value is more than 0.05 which is suggestive that duration of diabetes mellitus doesn't have significant association with contrast sensitivity function. As most of the patients include in present study were having diabetic duration of less than 10 years, no association between CSF and duration of diabetes was found (As shown in Table 12).

Here, p value is more than 0.05 so there is no association between blood pressure control and CSF as per study (As shown in Table 13).

Mean decimal equivalent VA of Right Eye of subjects with diabetes was 0.29 (6/12) and with healthy individual was 0.20 (6/9),

Mean decimal equivalent VA of Left Eye of subjects with diabetes was 0.20 (6/9) and with healthy individual was 0.22 (6/9),

P value is more than 0.05 which suggests that there isn't significant association in decimal equivalent VA in subjects with cataract, above observation is due to as above patients were having early or few cataract changes (As shown in Table 14).

Mean CSF of Right Eye of subjects with diabetes was 1.29 and with healthy individual was 1.27,

Mean CSF of Left Eye of subjects with diabetes was 1.31 and with healthy individual was 1.32,

Mean CSF of both Eyes of subjects with diabetes was 1.35 and with healthy individual was 1.34,

Binocular CSF is more than that of uniocular CSF. p value is more than 0.05 in all groups which leads us to the observation that there isn't significant association between CSF and cataract, Above observation is due to as above patients were having early or few cataract changes (As shown in Table 15).

DISCUSSION

Contrast describes the difference in the average luminance between 2 visible areas. Contrast sensitivity is the measure of the ability to detect a difference in the luminance between 2 areas. If the 2 areas are adjacent to each other, the ability to detect a difference in luminance is called spatial contrast sensitivity. If the areas occur sequentially in time, the ability to detect a difference in luminance is called temporal contrast sensitivity. The effects of diabetes on both types of contrast sensitivity have been studied with use of a large number of different tests.[5-8] The Pelli-Robson chart represents a reliable method of measuring spatial contrast sensitivity that is compatible with clinical practice. Accordingly, we chose to use this fairly quick and inexpensive test to study our diabetic patients to see what we could learn about the association of contrast sensitivity measurement and diabetic status of patients. To minimize other variables such as cataracts and possible intercurrent ocular conditions (e.g., glaucoma, age-related maculopathy), we chose to limit our test population to individuals with visual acuity of 20/40 or better as measured in the office. The patients were then retested using the Snellen visual acuity charts and the Pelli-Robson charts in a standardized manner with use of electrical display.

CONCLUSION

Evaluation of diabetic patients for contrast sensitivity using pelli robson contrast sensitivity charts is a good method of identifying diabetic changes of retina in its early stages. Presence of diabetic retinopathy is an indicator of disease severity. Majority of the subjects in the present study belonged to the age group 46-55 years (38.6%). Mean age of diabetic individuals was 51.42 with SD 9.18 and healthy individual mean age is 52.96 with SD 9.09. Total 18 patients with DR, among 57 diabetic patients were taken into study. Sex ratio in diabetic group is (Male: Female) 2.5:1 and healthy individual is (Male: Female) 2.1:1. There is significant reduction in contrast sensitivity function in subjects with diabetes as compared to healthy individuals. (P value<0.05). There is significant reduction in decimal equivalent VA in subjects with diabetes. (p value < 0.05). There is significant reduction in decimal equivalent BCVA in subjects with diabetes. (p value<0.05). There was significant association between high FBS level and diabetic retinopathy. (p value<0.05). There is significant association between FBS and PP2BS level with contrast sensitivity, the contrast sensitivity function decreases as metabolic control of blood sugar level fluctuates. (p value< 0.05).

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Raman R, Rani PK, Rachepalle SR, Gnanamoorthy P, Uthra S, Kumaramanickavel G, Sharma T. Prevalence of diabetic retinopathy in India: Sankara Nethralaya diabetic retinopathy epidemiology and

molecular genetics study report 2. Ophthalmology. 2009;116(2):311-8.
2. Nasralah Z, Robinson W, Jackson GR, Barber AJ. Measuring visual function in diabetic retinopathy: progress in basic and clinical research. J Clin Exp Ophthalmol. 2013;4(06):4-11.
3. Zulauf M, Flammer J. Correlation of spatial contrast sensitivity and visual fields in glaucoma. Graefe's archive for clinical and experimental ophthalmology. 1993;231(3):146-50.
4. Mutlukan E, Skarf B. Macular contrast sensitivity function correlates with automated threshold perimetry. Perimetry Update 1996/1997. 1997;1997:243-50.
5. Tan JC, Spalton DJ, Arden GB. The effect of neodymium: YAG capsulotomy on contrast sensitivity and the evaluation of methods for its assessment. Ophthalmology. 1999;106(4):703-9.
6. Wood JM, Lovie-Kitchin JE. Contrast sensitivity measurement in the detection of primary open angle glaucoma. 1991;497-502.
7. Mizokami KU, Asai TO. Contrast sensitivity, visual field defect, and retinal nerve fiber layer defect in glaucoma. Perimetry Update. 1988;1989;297-302.
8. Kuyk T, Elliott JL. Visual factors and mobility in persons with age-related macular degeneration. Journal of Rehabilitation Research and Development. 1999;36(4):303-12.

Cite this article as: Noticewala V, Shastri M. A study of contrast sensitivity changes in normal individual and diabetic patients with and without diabetic retinopathy. Int J Res Med Sci 2017;5:4840-5.