CHANGE IN CONTRAST SENSITIVITY AMONG PATIENTS WITH DIABETIC MELLITUS TYPE II.

Sabina Shrestha[1], Gunjan Prasai[2], Reshma Shrestha[3], Om Krishna Malla[4]*

Affiliation

1. *Professor, Department of Ophthalmology, Kathmandu Medical College, Nepal*
2. *Resident, Department of Ophthalmology, Kathmandu Medical College, Nepal*
3. *Lecturer, Department of Ophthalmology, Kathmandu Medical College, Nepal*
4. *Professor, Department of Ophthalmology, Kathmandu Medical College, Nepal*

ARTICLE INFO

Received : 11 December, 2021

Accepted : 16 November, 2022

Published : 27 February, 2023

ORA 319

DOI: https://doi.org/10.3126/bjhs.v7i3.52634

Corresponding Author

Dr. Sabina Shrestha

Professor

Department of Ophthalmology

Kathmandu Medical College, Nepal

Email: sabina_drs@hotmail.com

ORCID: https://orcid.org/0000-0001-5255-7490

Citation

Sabina Shrestha, Gunjan Prasai, Reshma Shrestha, Om Krishna Malla., Change in Contrast Sensitivity among Patients with Diabetic Mellitus Type II. , BJHS 2022;7(3)19. 1840 - 1844.

ABSTRACT

Introduction

Eye being one of the target organs of diabetes mellitus has many pathological consequences, one possibly being contrast sensitivity. Contrast sensitivity is required for daily activities like in situations of low light, fog or driving at night. The study was conducted to find out contrast sensitivity among diabetic patients.

Methodology

A hospital based descriptive cross- sectional study of contrast sensitivity was conducted among type II diabetics with or without retinopathy at Kathmandu Medical College from April to December 2018. Patient demographics and comprehensive clinical examinations findings were recorded in a specially designed proforma. Convenience sampling was done and informed consent was taken.

Leas symbol low contrast test 10M was used for contrast sensitivity testing. The contrast levels of the test lines on the five pages are 25%, 10%, 5%. 2.5%and 1.2%. Data was analyzed in excel and SPSS (version 21). Results were expressed in frequency, percentage and mean as required. Association of contrast sensitivity with age, gender, duration of diabetes, blood sugar level and diabetic retinopathy was tested using chi square test.

Result

Among the 45 study population, female to male ratio was 1:2. Age ranged from 25 to 76 years with maximum patients in the age group 51-60 years. Blood sugar was controlled in 33.33%. Contrast sensitivity was decreased in 40%. Among the patients with decreased contrast sensitivity, blood sugar was uncontrolled in 66.67%. Similarly, 72.2% of participants with decreased contrast sensitivity had no diabetic retinopathy. The association of contrast sensitivity with age of the patient, gender, duration of diabetes mellitus, blood sugar level and diabetic retinopathy was not statistically significant with p values 0.34, 0.52, 0.07, 1 and 0.89 respectively.

Conclusions

Contrast sensitivity can be decreased among patients with type II diabetes mellitus irrespective of gender, age of the patient, duration of diabetes, control of blood sugar and presence or absence of diabetic retinopathy.

KEYWORDS

Contrast sensitivity, diabetes, diabetic retinopathy.

INTRODUCTION

Type II diabetes mellitus is a metabolic disorder characterized by hyperglycemia and resulting from the combination of resistance to insulin action, inadequate insulin secretion, and excessive or inappropriate glucagon secretion. It is a global epidemic with significant ocular and systemic manifestations It involves both the anterior and posterior segment of the eyes. Diabetic retinopathy is one of the top five causes of visual impairment among the working population around the world. Of the total estimated global prevalence of blindness, 0.4 million is due to diabetic retinopathy. Approximately 95 million (35.4%) diabetic patients have diabetic retinopathy globally.[1]

An increasing urbanization and change in the lifestyle into more sedentary working habits have contributed to increasing burden of type 2 diabetes mellitus in Nepal. The prevalence of diabetes among people aged 20 years and above was 14.6% and among people aged 40 years and above was 19% in study conducted in urban population in Nepal.[2] Eye being one of the target organs in diabetes mellitus, it affects eyes in a variety of ways. However, although 21% of the diabetic patients on treatment had different grades of diabetic retinopathy, 50% of the participants had no knowledge regarding eye being involved due to diabetes. In a patient with diabetes, even when the visual acuity is normal, contrast sensitivity may be reduced even before the development of diabetic retinopathy.[3]

Contrast sensitivity which is the function of retina is the ability of visual system to appreciate differences between objects and their background at finest detail. It measures the ability to see details at low contrast levels. Visual information at low contrast levels is important in communication in faint shadows, in orientation and in motion as well as in near vision tasks like reading, writing and everyday tasks like cutting onion in low contrast, seeing in rain, snowfall and in dusk. Usually, contrast is created by the difference in luminance, the amount of reflected light, reflected from two adjacent surfaces.

This study was conducted to find out contrast sensitivity among diabetic patients.

METHODOLOGY

A hospital based cross- sectional analytical observational study conducted in Kathmandu Medical College Teaching Hospital(KMCTH). Patients with type II Diabetes mellitus with no other causes of retinopathy visiting ophthalmology department over a period of nine months (from April to December 2018) at KMCTH and giving consent to enroll were included in study. Patients with diabetes mellitus type I, cataract and glaucoma were excluded from the study. However, pseudophakic patients were included. Ethical clearance was obtained from institutional review committee of Kathmandu Medical College Teaching Hospital.

Contrast sensitivity was dependent variable while age, gender, duration of diabetes and diabetic retinopathy were independent variables. Anterior segment examination was done with Haag-Streit slit lamp and dilated fundus examination was done with + 90 Diopter lens in slit lamp for the presence or absence of diabetic retinopathy. Leas symbol low contrast test 10M was used for contrast sensitivity testing which is a valid and reliable tool. Lea contrast sensitivity test is useful in the evaluation of vision of patients revealing changes in visual function undetectable with the usual high contrast visual acuity test. The contrast levels of the test lines on the five pages are 25%, 10%, 5%. 2.5%and 1.2%. During testing, the test chart was kept vertical to have a constant luminance level. Patient demographics and comprehensive clinical examination findings were recorded in a specially designed proforma. Convenience sampling was done. Data were coded and entered in the computer in Excel and analyzed using Excel and SPSS (version 21). Results were expressed in frequency, percentage and mean as required. Fasting blood sugar less than 110 mg/dl was taken as controlled blood sugar as per the working definition. Association of contrast sensitivity with age, gender, duration of diabetes, blood sugar level and diabetic retinopathy was tested by chi square test and p value <0.05was taken as significant.

RESULTS

A total of forty- five type II diabetic patients visiting department of Ophthalmology of KMCTH completed the study. Among the participants, male is to female ratio was 2:1

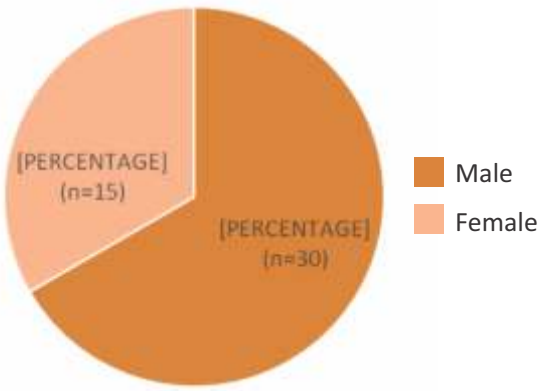

Figure 1: Distribution of Gender

Age ranged from 25 to 76 years with mean age 52.98 years. Contrast sensitivity was decreased in 40% (n=18) of the diabetic patients while it was normal in 60% (n=27).

Table 1:: Distribution of Age with contrast sensitivity

Age group	Normal contrast sensitivity (frequency)	Decreased contrast sensitivity (frequency)
>70	1 (3.70%)	3(16.67%)
61-70	6 (22.20%)	4(22.22%)
51-60	6 (22.20%)	6(33.33%)
41-50	11(40.74%)	4(22.22%)
31-40	4 (11.16%)	1(5.56%)
Total	27 (100%)	18(100%)

Maximum number of participants were in the age group 41-50 years while maximum number of participants with decreased contrast sensitivity were in the 5th decade of life.

The association of age and contrast sensitivity was not statistically significant with p value0.34.

Table 2: Status of blood sugar and contrast sensitivity

Blood Sugar Level	Normal contrast sensitivity (Frequency and Percentage)	Decreased contrast Sensitivity (Frequency and Percentage)	Total
Controlled	9 (33.33%)	6 (33.33%)	15
Uncontrolled	18 (66.67%)	12 (66.67%)	30
Total	27 (100%)	18 (100%)	45

Among the participants with decreased contrast sensitivity, blood sugar was not controlled in 66.67% while it was controlled in 33.33%. Association of contrast sensitivity with blood sugar levelwas not statistically significant with p value =1.

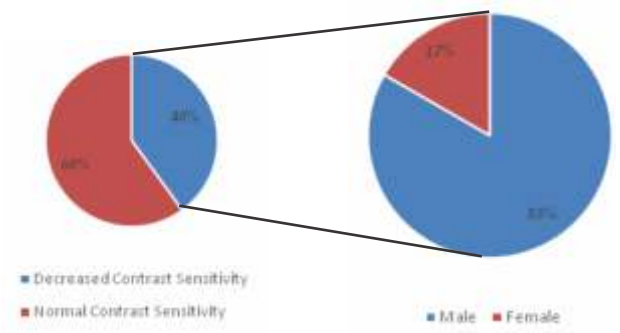

Figure 2: Distribution of Contrast Sensitivity and Gender

Contrast sensitivity was decreased more in male than female diabetic patients as 15 males and 3 females had decreased contrast sensitivity. However, association of contrast sensitivity with gender was also not statistically significant with p value = 0.052.

Table 3: Distribution of duration of diabetes and contrast sensitivity

Duration of Diabetes	Normal contrast sensitivity (Frequency and Percentage)	Decreased contrast Sensitivity (Frequency and Percentage)
< 10 years	24 (88.89%)	11 (61.11%)
10-20 years	2 (7.41%)	3 (16.67%)
>20 years	1 (3.70%)	4 (22.22%)
Total	27 (100%)	18 (100%)

Among the patients with decreased contrast sensitivity and duration of diabetes less than 10 years,only 5 patients had diabetes mellitusdiagnosed within the last year.Association of duration of diabetes mellitus and contrast sensitivity was not statistically significant with a p value of 0.07.

Table 4: Distributionof diabetic retinopathy and contrast sensitivity

Diabetic retinopathy	Decreased contrast sensitivity (Frequency and Percentage)	Normal contrast sensitivity (Frequency and Percentage)
Present	5 (27.78%)	7 (25.93%)
Absent	13(72.22%)	20 (74.07%)
Total	18 (100%)	27 (100%)

no diabetic retinopathy. The association of diabetic retinopathy with contrast sensitivity was also not statistically significant with p value= 0.89.

DISCUSSION

Diabetes Mellitus is a growing non-communicable disease in the urban community of Nepal. It may owe to the change in lifestyle to a more sedentary arrangement, change in dietary pattern and leading a more competitive and stressful life. Apart from visually disabling cataract and retinopathy, diabetes also affects the contrast sensitivity which is one of the visual functions.

Contrast sensitivity is important for visual information like reading facial expressions, for seeing in faint shadows, fog, rain and at night. Similarly, near vision activities like reading, and writing also require good contrast sensitivity.

Though diabetic retinopathy is essentially a vascular disorder, recent evidences have revealed many neural abnormalities like diabetic papillopathy present along with it.[4,5] In many studies, contrast sensitivity has been seen as an early indicator of retinopathy changes in diabetics before they develop any obvious vascular indicators clinically.[6,7] Various theories have been purposed for this, though a definite conclusion has been yet to be arrived to. Current literature associate contrast sensitivity decline as a result of structural changes in the inner retina due to changes in the magnocellular and parvocellular pathways.[8,9]

In a study by L Hyvarinen et al, among nineteen diabetic patients, contrast sensitivity may be decreased at intermediate and low spatial frequency without corresponding loss of visual acuity.[10]

Although significant hue discrimination and contrast sensitivity deficits were observed in diabetics with no retinopathy and diabetic with background retinopathy, contrast sensitivity was more abnormal more frequently than hue discrimination in a study by Trick GL et al.[2]

The threshold of contrast sensitivity among insulin dependent diabetic patients with or without retinopathy with age matched control showed significant losses with dynamic contrast sensitivity test. An early, usually nonselective neuronal damage of visual pathways has been found before the onset of clinically detectable retinopathy according to Di Leo MA et al.[11] It may be due to the effects of repetitive minor hypoglycemic insults contributing more than marked hyperglycemic condition. In the present study also, 72.22% of the patients with no diabetic retinopathy had decreased contrast sensitivity.

Contrast sensitivity was approximately 0.16 log units lower in patients with diabetes relative to controls both in moderate and dim background light conditions in a study by Safi Set al.[12] Different studies have shown that diabetic patients experience a decrease in contrast sensitivity which progresses with the severity of diabetic retinopathy and also prior to any clinical signs of retinopathy, contrast sensitivity is decreased in spite of excellent Snellen visual acuity.[13-19] In the present study also contrast sensitivity was decreased among diabetic both with and without diabetic retinopathy.

Contrast sensitivity examination has revealed functional insufficiency of the retina which was a sign of initial diabetic changes in foveolar and perifoveolar region structure.[15] Heravain J et al also suggest that prior to the detection of structural abnormalities by ophthalmoscopy or by fluorescein angiography, changes in visual function occurs among diabetic patients.[20] That is the reason for suggesting measurement of contrast sensitivity asa potential tool for screening early stages of diabetic retinopathy. Dossa AA et al also suggested neurosensory dysfunction occurring without any visible changes in the retina.[21] From the present study also we can come to a similar inference.

In a study by Khosla PK et al contrast sensitivity was significantly lower in diabetic eyes with and without retinopathy.[22] Similar results were found in study by Della SS et al, S Rashmi et al and Verotti A et al.[17,23,24] In a similar cross-sectional study like ours conducted by Rabia Saeed et. al, with almost the same sample size, a highly significant correlation was seen between the control status and duration of diabetes with decline in contrast sensitivity.[9]In the present study, the presence or absence of diabetic retinopathy was not related to decreased contrast sensitivity as 72.2% with decreased contrast sensitivity had no diabetic retinopathy.

There was a definite relation between glycemic control and contrast sensitivity in a study by Verotti A et.[24] In our study also among the participants with decreased contrast sensitivity, blood sugar was not controlled in 66.67%. In a study by De Marco R et al also contrast thresholds were not significantly related to the duration of diabetes and glycemic control.[25]In a study by S Rashmi et al also, an increase in duration of diabetes and poor diabetic control resulted in a decrease in contrast sensitivity among diabetic patients.[23]However, duration of diabetes and increasing age of the patient was not statistically significant for the decrease in contrast sensitivity in the present study which could be due to small sample size.

It has even been found that reduced contrast sensitivity is reversible among diabetics with or without background retinopathy but not with severe retinopathy.[24] This fact supports that with the glycemic control contrast sensitivity returns to normal. However, the present study was a cross sectional study with no scope of finding the reversibility of reduced contrast sensitivity with control of blood sugar level. Increasing severity of diabetic retinopathy was associated with decreased contrast sensitivity in a study by I M Gafour et al. However, the association of diabetic retinopathy with the decrease in contrast sensitivity was also not statistically significant in the present study probably due to small sample size.

CONCLUSION

Contrast sensitivity can be decreased among patients with diabetes mellitus irrespective of the age of the patient, duration of diabetes, control of blood sugar and presence or absence of diabetic retinopathy.

LIMITATION OF THE STUDY

The present study was a single centre, hospital-based study with limited number of participants andthe contrast sensitivity was measured using Leas symbol low contrast test 10M.

RECOMMENDATIONS

We would like to recommend a larger multi-centric study of similar kind with a larger group of population or a population- based study using Pellirobson contrast sensitivity chart.

ACKNOWLEDGEMENT

We would like to thank Kathmandu Medical College Teaching Hospital for allowing us to conduct this study and to the residents of Department of Ophthalmology there who helped in data collection.

CONFLICT OF INTEREST

None.

FINANCIAL DISCLOSURE

None

REFERENCES

1. Zheng Y, He M, Congdon N. The worldwide epidemic of diabetic retinopathy. Indian J Ophthalmol. 2012;60(5):428-431. doi:10.4103/0301-4738.100542 https://doi.org/10.4103/0301-4738.100542 PMid:22944754 PMCid:PMC3491270
2. Trick GL, Burde RM, Cordon MO, Santiago JV, Kilo C. The relationship between hue discrimination and contrast sensitivity deficits in patients with diabetes mellitus. Ophthalmology. 1988 May 1;95(5):693-8. DOI: 10.1016/s0161-6420(88)33125-8.https://doi.org/10.1016/S0161-6420(88)33125-8
3. Shrestha S, Malla OK, Karki DB, Byanju RN. Retinopathy in a diabetic population. Kathmandu Univ Med J (KUMJ). 2007 Apr-Jun;5(2):204-9. PMID: 18604020.
4. Davis MD, Fisher MR, Gangnon RE, et al. Risk factors for high-risk proliferative diabetic retinopathy and severe visual loss: Early Treatment Diabetic Retinopathy Study Report #18. Invest Ophthalmol Vis Sci. 1998; 39: 233-252.
5. Wilkinson CP, Ferris FLIII, Klein RE, et al. Proposed international clinical diabetic retinopathy and diabetic macular edema disease severity scales. Ophthalmology. 2003; 110: 1677-1682 https://doi.org/ 10.1016/S0161-6420(03)00475-5
6. Banford D, North RV, Dolben J, Butler G, Owens DR. Longitudinal study of visual functions in young insulin dependent diabetics. Ophthalmic Physiol Opt. 1994; 14: 339-346.https://doi.org/ 10.1111/j.1475-1313.1994.tb00122.x PMid:7845689
7. Gualtieri M, Bandeira M, Hamer RD, Damico FM, Moura AL, Ventura DF. Contrast sensitivity mediated by inferred magno- and parvocellular pathways in type 2 diabetics with and without nonproliferative retinopathy. Invest Ophthalmol Vis Sci. 2011; 52: 1151-1155 https://doi.org/10.1167/iovs.09-3705 PMid:21051718
8. Montesano G, Gervasoni A, Ferri P, et al. Structure-function relationship in early diabetic retinopathy: a spatial correlation analysis with OCT and microperimetry. Eye (Lond). 2017; 31: 931-939. https://doi.org/10.1038/eye.2017.27 PMid:28257130 PMCid:PMC5518836
9. Saeed R, Iqbal I, Bajwa JA, et al. Evaluation of color vision and contrast sensitivity in diabetic patients without retinopathy. Adv Ophthalmol Vis Syst. 2019;9(3):71-76. DOI: 10.15406/aovs.2019.09.00349 https://doi.org/10.15406/aovs.2019.09.00349
10. Lea Hyvarinen, PenttiLaurinen, Jyrki Rovamo. Contrast sensitivity in evaluation of visual impairment due to diabetes. Acta Ophthalmogica.1983; 61(1):1755-1768. https://doi.org/ 10.1111/j.1755-3768.1983.tb01399.xPMid:6858649
11. Di Leo MA, Caputo S, Falsini B, Porciatti V, Minnella A, Greco AV, Ghirlanda G. Nonselective loss of contrast sensitivity in visual system testing in early type I diabetes. Diabetes care. 1992 May 1;15(5):620-5. DOI: 10.2337/diacare.15.5.620 https://doi.org /10.2337/ diacare.15.5.620 PMid:1516480
12. Safi S, Rahimi A, Raeesi A, Safi H, Amiri MA, Malek M, Yaseri M, Haeri M, Middleton FA, Solessio E, Ahmadieh H. Contrast sensitivity to spatial gratings in moderate and dim light conditions in patients with diabetes in the absence of diabetic retinopathy. BMJ Open Diabetes Research and Care. 2017 Aug 1;5(1). DOI: 10.1136/bmjdrc-2017-000408 https://doi.org/10.1136/bmjdrc-2017-000408 PMid:28878937 PMCid:PMC5574432
13. Arend O, Remky A, Evans D, Stüber R, Harris A. Contrast sensitivity loss is coupled with capillary dropout in patients with diabetes. Investigative ophthalmology & visual science. 1997 Aug 1;38(9): 1819-24. hptt://iovs. arvojournals.org/ article.aspx? articleid= 2180952
14. North RV, Farrell U, Banford D, Jones C, Gregory JW, Butler G, Owens DR. Visual function in young IDDM patients over 8 years of age: A 4-year longitudinal study. Diabetes care. 1997 Nov 1;20(11):1724-30. DOI: 10.2337/diacare.20.11.1724 https://doi.org/10.2337/ diacare.20.11.1724 PMid:9353616
15. Sukha AY, Rubin A. High, medium, and low contrast visual acuities in diabetic retinal disease. Optometry and Vision Science. 2009 Sep 1;86(9):1086-95. DOI: 10.1097/OPX.0b013e3181b48635. https://doi.org/ 10.1097/OPX.0b013e3181b48635 PMid:19668018
16. Regan D, Neima D. Low-contrast letter charts in early diabetic retinopathy, ocular hypertension, glaucoma, and Parkinson's disease. British journal of ophthalmology. 1984 Dec 1;68(12):885-9. DOI:10.1136/bjo.68.12.885 https:// doi.org/ 10.1136/ bjo.68.12.885 PMid:6509009 PMCid:PMC1040503
17. Della Sala S, Bertoni G, Somazzi L, Stubbe F, Wilkins AJ. Impaired contrast sensitivity in diabetic patients with and without retinopathy: a new technique for rapid assessment. British journal of ophthalmology. 1985 Feb 1;69(2):136-42. DOI: 10.1136/bjo.69.2.136 https://doi.org/10.1136/bjo.69.2.136 PMid:3967001 PMCid:PMC1040540
18. Sokol S, Moskowitz A, Skarf B, Evans R, Molitch M, Senior B. Contrast sensitivity in diabetics with and without background retinopathy. Archives of ophthalmology. 1985 Jan 1;103(1):51-4. DOI: 10.1001/archopht.1985.01050010055018 https://doi.org/10.1001/archopht. 1985.01050010055018 PMid:3977675
19. Neriyanuri S, Pardhan S, Gella L, Pal SS, Ganesan S, Sharma T, Raman R. Retinal sensitivity changes associated with diabetic neuropathy in the absence of diabetic retinopathy. British Journal of Ophthalmology. 2017 Sep 1;101(9):1174-8. DOI: 10.1136/bjophthalmol-2016-309641. https://doi.org/10.1136/bjophthalmol-2016-309641 PMid:28108570
20. Heravian J, Shoeibi N, Azimi A, Yasini S, Ostadi Moghaddam H, Yekta A, Esmaily H. Evaluation of contrast sensitivity, color vision and visual acuity in patients with and without diabetes. Iranian Journal of Ophthalmology. 2010 Sep 10;22(3):33-40. http://irjo.org/article-1-376-en.pdf
21. Dosso AA, Yenice-Ustun F, Sommerhalder J, Golay A, Morel Y, Leuenberger PM. Contrast sensitivity in obese dyslipidemic patients with insulin resistance. Archives of ophthalmology. 1998 Oct 1;116(10):1316-20. DOI: 10.1001/archopht.116.10.1316 https://doi.org/ 10.1001/archopht.116.10.1316 PMid:9790629
22. Khosla PK, Talwar D, Tewari HK. Contrast sensitivity changes in background diabetic retinopathy. Canadian journal of ophthalmology. Journal canadiend'ophtalmologie. 1991 Feb;26(1):7.
23. Rashmi S, Varghese RC, Anupama B, Hegde V, Jain R, Kotian H. Contrast sensitivity in diabetic patients without retinopathy and it's correlation with the duration of diabetes and glycemic control. IOSR J Dent Med Sci [serial online]. 2016;15(08):11-3. DOI: 10.9790/0853-1508061113 https://doi.org/10.9790/0853-1508061113
24. Verrotti A, Lobefalo L, Petitti MT, Mastropasqua L, Morgese G, Chiarelli F, Gallenga PE. Relationship between contrast sensitivity and metabolic control in diabetics with and without retinopathy. Annals of medicine. 1998 Jan 1;30(4):369-74. DOI: 10.3109/07853899809029936 https://doi.org/10.3109/07853899809029936 PMid:9783835
25. De Marco R, Capasso L, Magli A, Franzese A, Gasparini N, Ambrosio G. Measuring contrast sensitivity in aretinopathic patients with insulin dependent diabetes mellitus. Documentaophthalmologica. 1997 Sep 1;93(3):199-209. https://doi.org/10.1007/BF02569060https://doi.org/10.1007/BF02569060 PMid:9550348