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Original Research Article

Effect of ocular diseases on contrast sensitivity: A cross sectional study

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Abstract

This study was aimed at assessing the relationship between different types of ocular diseases with contrast sensitivity. Total of 97 pre diagnosed patients were included in this study (both eyes involved).Contrast sensitivity measured by Lea Symbols chart and were taken from 4m, 3m, 2m, 1m, 50cm and 25cm. Data were analysed using statistical packaging for social sciences version 25.0. From current study total of 52(100%) subjects were having cataract and out of which 50 (96.2%) were having poor contrast sensitivity. 8 (100%) subjects were having glaucoma out of which 7 (87.5%) were having poor contrast. 4 (100%) subjects were having macular degeneration and out of them 3 (75%) were having poor contrast. 14 (100%) subjects were having dry eyes and out of which 11 (78.6%) were having poor contrast. 10 (100%) subjects were having amblyopia out of which 6 (60%) were having poor contrast. 5 (100%) subjects were having diabetic retinopathy and all of them 5 (100%) were having poor contrast. 4 (100%) subjects were having optic neuritis and 3 (75%)) were having poor contrast. This study showed that ocular diseases affect contrast sensitivity.

Keywords: Ocular disease and contrast sensitivity, contrast sensitivity, ocular diseases.

INTRODUCTION

The visual system works over an exceptional range of lighting conditions through transduction by two classes of photoreceptor cells, rods and cones (Barbur and Stockman, 2010). Contrast sensitivity is the ability to detect, differentiate or identify objects that vary slightly in relative luminance, difference in contrast sensitivity is due to the differences in sensitivity of retinal ganglion cells (Kaplan and Shapley, 1986). Contrast sensitivity is very important part of visual performance and many tasks are directly linked with contrast sensitivity such as driving, reading and navigation (Habiba and Hussain, 2017). Many studies have also proven some more tasks associated with contrast sensitivity such as face recognition, computer task precision and reading speed (Haymes et al., 2006).

Some studies also revealed that measurement of contrast sensitivity can be used for the early diagnosis of many ocular diseases and even to monitor their progression as well such as glaucoma, cataract, diabetic retinopathy, optic neuritis and macular degeneration. It is also helpful in terms of evaluating the results of some surgical procedures as well such as post cataract surgery, laser capsulotomy, laser photocoagulation and refractive surgery (Haymes et al., 2006; Arditi, 2005).

A more extensive measure of visual function is contrast sensitivity and its decline remarkably affect the quality of life (Owsley, 2003). A study revealed that chance of fall is associated with decreased contrast sensitivity (Freedman and Thibos, 1975). Contrast sensitivity is also impaired in dry eye, amblyopia, glare, myopia, cerebral lesions and multiple sclerosis (Rolando et al., 1998; Abrahamson and Sj¨ostrand, 1986; Collins and Carney, 1990; Bodis-Wollner, 1972; Regan et al., 1981). And very importantly contrast sensitivity is also

disturbed in visual neuropathologies in which visual acuity remain unaffected (Jindra and Zemon, 1989; Woods and Wood, 1995).

Most commonly used charts are grating or letters at different level of luminance to detect patient's foveal contrast threshold. The cycle per degree of grating or the size of the letter describe the spatial frequency. Most commonly used chart is letter contrast chart because it's very easy to perform and many patients prefer this chart (Ginsburg, 1981). Both kind of charts (grating, letter) are performed under systematize lighting but their result can be affected by irregular lightening, reflection, fading, learning and use of bad testing method (Woo and Bohnsack, 1986).

Loss of contrast sensitivity doesn't mean to have any particular disease but in many diseases contrast sensitivity may be helpful in diagnosis and monitoring of its progression related to some therapeutic drug. The U.S Food and Drug Administration write down contrast sensitivity as visual function endpoint (Weinreb and Kaufman, 2009). The result of contrast sensitivity is very helpful to detect minor changes within very short period of time (Shoshani et al., 2011).

A Study revealed that glaucoma patients who were having better than 0.3 log MAR visual acuity but significantly reduced contrast sensitivity (Hawkins et al., 2003). Contrast sensitivity were also reported as reduced in patients with early cataract and macular degeneration where visual acuity were almost good (Elliott and Situ, 1998; Shandiz et al., 2011; Midena et al., 1997).

MATERIALS AND METHODS

Research Design

This was a cross-sectional study. A pre designed questionnaire was used to collect the data from participants.

Location of Study

Data was collected from eye OPD of Pakistan Institute of Medical Sciences (PIMS) Islamabad Pakistan from November 2018 to January 2019.

Sample of Study Population

A total of 97 already diagnosed patients with different types of ocular diseases were selected for this study.

Inclusion criteria

Patients from 7 to 60 years of age.
Both genders were included.
Patients already diagnosed with ocular disease.

Exclusion criteria

Patients with presenting visual acuity less than 6/60.
Mentally retarded.
Patients who were not willing to participate.

Ethical Consideration

This study was duly approved by the ethical committee of Pakistan Institute of Rehabilitation Sciences (PIRS) Isra University Islamabad.

RESULTS

Table 1 shows contrast sensitivity of Ocular Dexter for each ocular health category. There were 52 patients with cataract from which only 2 of them had good contrast sensitivity, rest of them had reduced contrast sensitivity. There were 8 patients with glaucoma from which 7 had reduced contrast sensitivity. There were 4 patients with macular degeneration, 3 had reduced contrast sensitivity. In case of dry eye patients, there were 14 patients in total, out of which 11 had reduced contrast sensitivity. There were 10 amblyopic patients, out of which 6 had reduced CS and 4 had good contrast sensitivity. There were 5 patients with diabetic retinopathy and all of them had reduced contrast sensitivity. Lastly, there were 4 patients with optic neuritis, out of which, only 1 had good CS while rest of the 3 had reduced contrast sensitivity. Hence, there was a significant difference between contrast sensitivity of Ocular Dexter and ocular health of patients ($p=0.000$).

Table 2 shows observed contrast sensitivity of Ocular Sinister for each ocular health category. There were 52 patients with cataract from which only 4 of them had good contrast sensitivity, while 48 had reduced CS. There were 8 patients with glaucoma and all of them had reduced CS. There were 4 patients with macular degeneration, 2 had reduced contrast sensitivity and rest of the 2 had good CS. In case of dry eye patients, there were 14 patients in total, out of which only 2 had good contrast sensitivity, while 12 had reduced CS. There were 10 amblyopic patients, out of which 4 had reduced contrast sensitivity and 6 had good CS. There were 5 patients with diabetic retinopathy and all of them had reduced CS. Lastly, there were 4 patients with optic neuritis, out of which, only 1 had good CS while rest of the 3 had reduced CS. Hence, there was a significant difference between contrast sensitivity of Ocular Sinister and ocular health of patients ($p=0.000$).

Table 1. Ocular Health * Contrast Sensitivity Ocular Dexter.

Ocular Health	Contrast Sensitivity Ocular Dexter			Chi Square Value	P-Value
	Good	Reduced	Total		
Cataract	2	50	52		
Glaucoma	1	7	8		
Macular Degeneration	1	3	4		
Dry Eye	3	11	14	159.130	0.000
Amblyopia	4	6	10		
Diabetic Retinopathy	0	5	5		
Optic Neuritis	1	3	4		

Table 2. Ocular Health * Contrast Sensitivity Ocular Sinister.

Ocular Health	Contrast Sensitivity Ocular Sinister			Chi Square Value	P-Value
	Good	Reduced	Total		
Cataract	4	48	52		
Glaucoma	0	8	8		
Macular Degeneration	2	2	4		
Dry Eye	2	12	14	156.727	0.000
Amblyopia	6	4	10		
Diabetic Retinopathy	0	5	5		
Optic Neuritis	1	3	4		

DISCUSSION

The contrast sensitivity of cataract patients was shown to be significantly decreased in both eyes (50/52 OD, 48/52 OS) in this study. Similarly, the contrast sensitivity of all of the diabetic retinopathy patients (4 out of 4) was lowered in both eyes. The presence of diabetic retinopathy appeared to dampen the contrast sensitivity response more than the presence of cataract, according to these findings. These findings are similar to those of a previous study (Howes et al., 1982) that found that diabetic retinopathy and cataract patients had lower contrast sensitivity responses. The reduction of contrast sensitivity was found to be caused by background retinopathy, especially at the low and medium frequencies. The reduction of sensitivity to low and medium spatial frequencies was associated with mild cataract, whereas moderate cataract suppressed sensitivity to all frequencies. As a result, both studies' findings show that contrast sensitivity testing could be a useful screening tool for diabetic retinopathy and cataract. Our findings corroborate those of another study, which found that diabetic retinopathy patients had worse contrast sensitivity functions than age-matched controls (Trick et al., 1988).

Campbell and Green were the first to describe a decrease in contrast sensitivity in patients with primary open-angle glaucoma (Campbell and Green, 1965). According to several studies, contrast sensitivity of glaucoma and normal eyes differ significantly. Patients with glaucoma had reduced contrast sensitivity in the current study (7/8 OD, 8/8 OS). These findings are similar to those of a study in which the difference in overall contrast sensitivity function between healthy and glaucoma eyes was significant (P<.001), indicating that glaucoma patients had significantly lower CS than healthy patients eyes (Sample et al., 1991). Hence, it is inferred that spatial contrast sensitivity could be a valuable supplementary diagnostic test for glaucoma, but interpreting the results without other clinical data could lead to diagnostic errors.

Several earlier studies have found that patients with macular degeneration have a change in their contrast sensitivity function. In present study, patients with macular degeneration (3/4 OD, 2/4 OS) had reduced contrast sensitivity. A previous study (Loshin and White, 1984) reported almost identical results in 40 patients with macular degeneration, with a reduction in contrast sensitivity at all spatial frequencies and a shift of the peak toward lower spatial frequencies. These findings show that contrast charts may be beneficial for evaluating vision loss not noticed by standard Snellen charts in patients with macular degeneration.

According to a study, dry eye patients usually have normal acuity on Snellen charts, allowing them to observe for longer periods of time, but they have lower contrast sensitivity under the right stimulus conditions (Ridder et al., 2011). In present study, (11/14 OD, 12/14

OS) patients had reduced contrast sensitivity. These findings are similar to those of a prior study in which dry eye patients had a significant drop in spatial-contrast sensitivity ranging from 35 to 70% when compared to a group of age-matched normal eyes employed as a control. Moreover, even in the presence of intact corneal surface, spatial-contrast sensitivity was substantially reduced (Rolando et al., 1998). The cause of reduced contrast sensitivity in both studies could be tear film abnormalities associated with dry eye disease, which can impair transfer function of modulation of ocular surface.

CONCLUSION

This study confirm that ocular diseases effect contrast sensitivity with direct relation because they either effect ocular media or effect optic nerve and macula which ultimately effect contrast sensitivity. This study revealed that diabetic retinopathy (100%) and cataract (96.2%) are the two most common causes of reduced contrast sensitivity.

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