Original Paper

Contrast Sensitivity Change– A Tool of Monitoring Glaucoma Progression

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Abstract

Introduction: Glaucoma is a potentially blinding disease, causing gradual loss of sight. It is often associated with increased intraocular pressure that can damage the optic nerve, which transmits images to the brain. Glaucoma can lead to permanent vision loss, if the damage continues. Without treatment, glaucoma can cause total permanent blindness within a few years. Glaucoma is one of the major causes of ocular morbidity and primary open–angle glaucoma is a major health problem. The prevalence of primary open- angle glaucoma (POAG) is estimated as being from 1.1-3% of western populations, over the age of 40 years, in both past and more recent population surveys.

Objective: To evaluate and compare the value of Contrast sensitivity (CS) and automated perimetry among primary open-angle glaucoma (POAG) patients, glaucoma suspects and normal control.

Materials and Methods: It was a prospective observational hospital based study conducted in National Institute of Ophthalmology & Hospital (NIO&H), Dhaka during the period from January 2006 to December 2006. A total of 30 POAG patients, 30 glaucoma suspects and 30 normal control subjects were recruited for the study. After complete baseline evaluation, all the study subjects underwent visual field assessment by Octopus automated field analyzer and CS evaluation by Low Contrast Flip Chart. Outcome measures were baseline CS of POAG patients, glaucoma suspects and normal controls, mean CS of POAG patients at 3 months after treatment, baseline MS of POAG patients, glaucoma suspects and normal controls in Octopus perimetry and retinal mean sensitivity (MS) of POAG patients 3 months after treatment.

Results: Among the POAG patients MS was 22.23 dB, among glaucoma suspects MS was 27.50 dB and among normal controls mean MS was 30.0 dB; among the POAG patients mean CS was 2.99% whereas it was 2.20% and 1.41% respectively among glaucoma suspects and normal controls. Baseline CS had negative correlation with MS among POAG patients (correlation co-efficient, r = -0.908). It indicates that better CS is associated with higher MS. Out of 30 cases of POAG, 20 (66.67%) received medical and 10 (33.33%) received surgical treatment. Mean CS improves to 2.66% from baseline 2.99% after treatment and MS improves to 23.16 dB from base 22.23 dB after treatment. Correlation after three months of treatment was significantly negative (r = -0.86).

Conclusion: As increased loss of MS of perimetry has been found to be associated with increased loss of CS, assessment of CS may become an easy, convenient tool for glaucoma diagnosis.

Key-words: Glaucoma, permanent vision loss, Primary open-angle glaucoma (POAG), Contrast sensitivity (CS).

Introduction

Glaucoma is defined as an optic neuropathy characterized by a typical appearance of the optic nerve head and characteristic visual field loss; diagnosis is based on a combination of factors including intraocular pressure (IOP), optic disc (and nerve fibre layer) damage and specific field defects[1].

Glaucoma is one of the major causes of ocular morbidity and primary open–angle glaucoma (POAG) is a major health problem. The prevalence of POAG is estimated as being from 1.1-3% of western populations, over the age of 40 years, in both past and more recent population surveys[2,3].

In the natural history of a glaucomatous optic neuropathy, certain types of functional visual loss may occur substantially sooner than shown by standard visual fields[4]. In particular, defects in CS have been reported in some subjects before observable nerve fiber damage of visual field loss on standard

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achromatic computer-assisted perimetry[5-8]. While testing the reproducibility of a novel chart developed for measuring spatial contrast sensitivity, Pomerance and Evans[9] showed an improvement of foveal spatial CS thresholds after a short term course of topical B-blockers in a limited series of glaucomatous eyes. The optic nerve damage in glaucoma affects CS to a greater extent than visual acuity[10].

CS is a measure of the smallest distinguishable contrast and indirectly assesses the quality of vision. Assessment of CS is indicated for patients who have visual problems despite a normal visual acuity. It is a measure of optic nerve disease[5]. Assessment of CS reflects magnocellular function which may help in early detection of glaucoma when perimetric changes still to appear.

Materials and Methods

This is a prospective observational hospital based study done in NIO&H, Dhaka spanning from January 2006 to December 2006. The study included patients of both sexes of age ranging from 40 years to 80 years with visual acuity > 6/12 who were suffering from POAG or glaucoma suspects attending glaucoma clinic and normal control subjects attending OPD for some other conditions that do not affect visual acuity and contrast sensitivity. Patients of angle closure glaucoma or secondary glaucoma, cataract, optic nerve disease and phakic or psdudophakic were excluded from the study. A total of 30 POAG and 30 glaucoma suspects along with 30 normal subjects were recruited for the study. The sample technique was purposive and non-randomized.

General systemic and ocular examinations of the subjects were done. The ocular examinations included visual acuity (unaided, with pinhole and corrected), cornea, anterior chamber, lens, iris, pupil (anatomy and reaction), fundus (Media, disc, NRR, CD ratio), IOP (in mm), angle status. The investigations done were color fundus photograph and Octopus visual field analysis. CS was assessed by Low Contrast Flip Chart. Only POAG patients those received surgical or medical treatment were kept under observation and had a follow up after 3 months and repeat automated perimetry and CS assessment was done.

Results

The mean age of POAG patients was 54.60±9.93 (SD) years, glaucoma suspects were 53.33±8.84 years and controls was 54.33±9.19 years. Among 30 POAG patients 16(53.33%) were male and 14(46.67%) were female. Among glaucoma suspects 15 male (50%) and 15 female (50%) and among controls 17(56.66%) were male and 13(44.34%) were female. The Table-I shows the distribution of baseline IOP, Table-II the distribution of baseline visual acuity in LogMAR, Table-III the distribution of MS in dB, Table-IV the distribution of mean value of CS and Table-V the distribution of mean baseline CS and MS comparing with mean CS and MS after 3 months of treatment.

Table-I: Distribution of baseline IOP among the study subjects

IOP (mm of Hg)	POAG patients	Glaucoma Suspects	Control
Mean±SD	27.56±2.67	25.56±3.73	14.90±2.9
Maximum	33	34	20
Minimum	24	20	10

Table-II: Distribution of VA in logMAR among the study subjects (n=30)

VA (LogMAR)	POAG patients	Glaucoma Suspects	Control
Mean ± SD	0.15±0.10	0.076±0.10	0.02±0.06
Maximum	00	00	00
Minimum	0.3	0.3	0.2

Table-III: Distribution of mean value of MS (MS) among the study subjects (n=30)

MS (dB)	POAG patients	Glaucoma Suspects	Control
Mean ± SD	22.23±2.82	27.5±1.81	30.0±2.51
Maximum	26	30	34
Minimum	16	24	26

Table-IV: Distribution of mean value of CS among the study subjects (n=30)

Mean CS (%)	POAG patients	Glaucoma Suspects	Control
Mean ± SD	2.99±1.52	2.20±1.25	1.41±0.43
Maximum	1.25	1.25	1.25
Minimum	5	5	2.5

Table-V: Distribution of mean baseline CS and MS comparing with mean CS and MS after 3 months of treatment

Parameter	Baseline Value	3 months after treatment
CS (%)	2.99	2.66
MS (dB)	22.23	23.16

Discussion

Contrast is a suitable parameter to study because perceptually, object recognition is highly invariant to contrast changes beyond a minimal contrast level. However, retinal responses are highly sensitive to all contrast levels. Consequently, the contrast response function can be used as a tool to explore to what extent activation in a given visual area is determined by the physical contrast of the stimulus and to what extent it is related to the subject's perceptual performance[6].

The baseline mean IOP among normal control group was 14.90 mm of Hg, glaucoma suspects was 25.83 mm of Hg and among POAG patients it was 27.56 mm of Hg. Mathai et al[7] showed that the control group had

IOP < 21 mm of Hg, glaucoma suspects had an IOP of >21 mm of Hg and POAG > 25 mm of Hg prior to treatment which is consistent with the study.

The mean visual acuity in LogMAR unit among POAG patients was 0.15, among glaucoma suspects was 0.07 and it was 0.02 in normal controls. Patients with a diagnosis of glaucoma, glaucoma suspect or ocular hypertension whose visual acuity was 20/40 (LogMAR=0.3) or better were included in the study after Wilensky and Hawkins[8].

Among 30 POAG patients, mean value of MS was 22.23 dB; among glaucoma subjects mean MS was 27.50 dB and among normal controls it was 30.0 dB. Again the mean value of CS (in percentage) among POAG patients was 2.99%; among glaucoma subjects it was 2.20 and in normal controls it was 1.41%.

Association of CS and visual fields in glaucoma was studied by Sponsel et al[11] which showed no significant difference in mean CS levels among their three study groups. But Tochel et al[12] found correspondence between abnormally high contrast thresholds and visual field loss in the truncated quadrants which was significant in 5 (25%) patients, borderline in 4 patients (20%) and absent in 9(45%) patients.

The central aim of the study, however, was whether the contrast threshold results reflected the amount of visual field loss measured by perimetry. In three groups of subjects (POAG, glaucoma suspects and normal control) change of CS was found to be correlated with the change in visual field. This gives the idea that assessment of CS may become another alternative diagnostic tool for evaluating as well as monitoring of treatment progress in glaucoma patients.

Conclusion

Glaucoma is a progressive disease which needs regular follow up to assess the extent of sight nerve damage. The most reliable tool of this is assessment of visual field analysis which is an experience procedure. As increased loss of MS of perimetry has been found to be associated with increased loss of contrast sensitivity, assessment of CS may become an easy, convenient tool for glaucoma diagnosis.

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