ARVO # 211/ A452
May 06, 2012
SUPPORTED BY
Research to Prevent Blindness

Correlation Between Inter-eye Difference In Visual Field Global Index Values And Pupillary Response As Measured By An Automated Pupillometer In Subjects With Glaucoma

Angelo P. Tanna[1], Daniel Sarezky[1], Theodore Krupin[1], Charles Wm. Stewart[2], Aaron Cohen[2], Nicholas J. Volpe[1]
1. Department of Ophthalmology, Northwestern University Feinberg School of Medicine, Chicago, IL
2. Konan Medical USA, Irvine, CA

Introduction

The severity of glaucomatous optic neuropathy tends to be asymmetric. In a visual field analysis of 740 patients with glaucoma, Poinoosawmy et al. reported that among patients with visual field damage in at least one eye, 82% presented with mean deviation (MD) asymmetry ≥2 dB. Given this result, it follows that quantitative, automated assessment of the relative afferent pupillary response may be of utility in the detection of some subjects with glaucoma.

Purpose

To evaluate the effectiveness of a new binocular infrared computerized pupillometer in the quantitative measurement of the relative afferent pupillary response in patients with glaucoma by assessing the correlation of the inter-eye difference in visual function as measured by standard automated perimetry with the inter-eye difference in the afferent pupillary response.

Design

Prospective, observational study

Methods

Twenty-three patients with glaucoma underwent examination with a prototype, automated, binocular pupillometer designed by Konan Medical USA. White, full-field visual stimuli were presented monocularly, alternating to each eye, while the fellow eye continued to view a nominal background and fixation target as a cyclopean scene. The machine was also capable of presenting colored, hemifield, quadrant, macular stimulating, and macular sparing stimuli, but those data are not presented here.

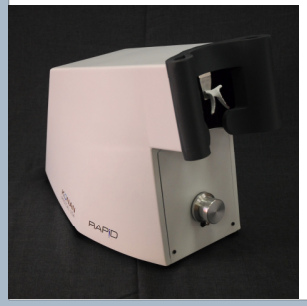

Figure 1: The automated pupillometer

Methods

Pupils were tracked with two 60 Hz infrared cameras recording simultaneous bilateral images, each with a resolution of 240 X 240 pixels/frame for approximately 23 pixels/mm. For each stimulus presentation, the amplitude of pupil constriction for each eye was defined:

$$\frac{\text{DIAMETER resting} - \text{DIAMETER constricted}}{\text{DIAMETER resting}}$$

The mean of the amplitudes of pupil constriction of the two eyes, in response to the same stimulus presentation, was calculated. Eight stimuli pairs were presented. The median of the mean amplitudes of pupil constriction in response to right eye and left eye stimulation was determined. A "RAPD score," a log ratio that represented the relative asymmetry in pupillary constriction between the monocular stimuli, was defined:

$$\log_{10}\left(\frac{\text{Median Amplitude of Pupil Constriction [in Response to Right Eye Stimulation]}}{\text{Median Amplitude of Pupil Constriction [in Response to Left Eye Stimulation]}}\right) \text{ X } 10$$

Within nine months of pupillography, all patients underwent SAP using the Humphrey Field Analyzer IIi, 24-2, Swedish Interactive Threshold Algorithm. Correlations between the inter-eye difference in the afferent pupillary response and the inter-eye difference in mean deviation (MD) and pattern standard deviation (PSD) were explored.

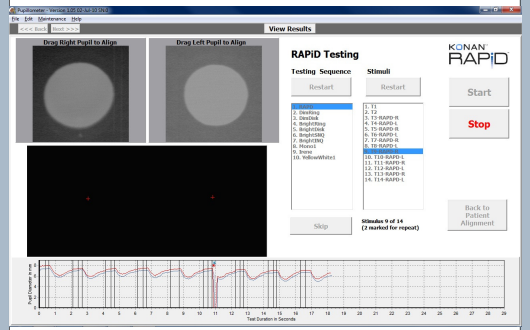

Figure 2: The pupillometer's interface. The asterisk above the pupil tracings marks a blink that interrupted the sequence. The interrupted pair of monocular stimuli were automatically repeated at the end of the trial.

Results

The inter-eye differential pupillary response as measured by RAPD scores was 0.69 ± 0.59 (log units, mean ± standard deviation (SD)). The inter-eye difference in MD was 5.67 dB ± 5.29 (mean ± SD), and the inter-eye difference in PSD was 3.61 dB ± 3.20 (mean ± SD). There was a strong correlation between the inter-eye difference in the afferent pupillary response and the inter-eye difference in MD ($r = -0.77$ (Spearman correlation coefficient), $p < 0.001$) and PSD ($r = 0.57$, $p = 0.01$).

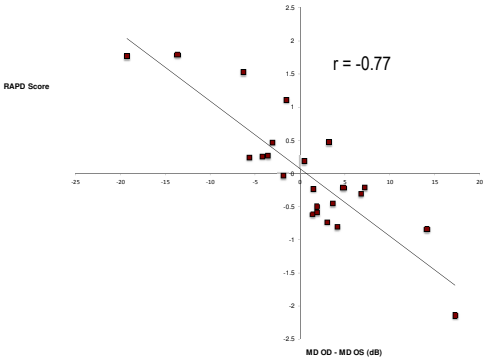

Figure 3: RAPD score vs. Inter-eye Mean Deviation Difference (right eye minus left eye). Negative RAPD scores signify subjects with a left relative afferent pupillary defect. The Spearman correlation coefficient is $r = -0.77$, $p < 0.001$.

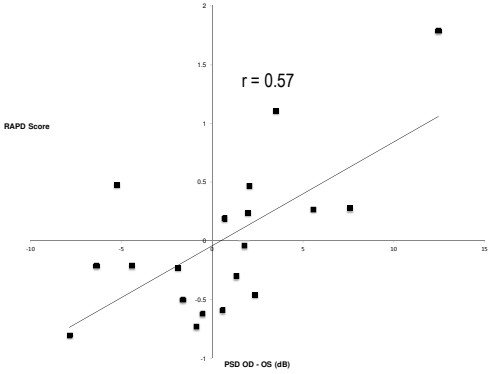

Figure 4: RAPD score vs. Inter-eye Pattern Standard Deviation Difference (right eye minus left eye). The Spearman correlation coefficient is $r = 0.57$, $p = 0.01$.

Conclusions

A new, binocular computerized pupillometer provides an automated method for the quantitative assessment of the afferent pupillary response. In patients with glaucoma, the inter-eye asymmetry in the pupil response correlates strongly with asymmetry in visual function, as measured by standard automated perimetry. In eyes with diffuse glaucoma damage, MD values more accurately summarize the level of severity of the glaucomatous visual field damage than do PSD values. Future studies are needed to evaluate the clinical utility of automated pupillography in the detection and management of patients with glaucoma, especially to determine its value as a screening tool in distinguishing patients with glaucoma from normal subjects.

References

Kalaboukhova L, Fridhammar V, Lindblom B. Relative afferent pupillary defect in glaucoma: a pupillometric study. Acta Ophthalmol Scand. 2007;85(5):519-525.

Lagrèze WD, Kardon RH. Correlation of relative afferent pupillary defect and estimated retinal ganglion cell loss. Graefes Arch Clin Exp Ophthalmol. 1998;236(6):401-404.

Lankaranian D, Altangerel U, Spaeth GL, Leavitt JA, Steinmann WC.The usefulness of a new method of testing for a relative afferent pupillary defect in patients with ocular hypertension and glaucoma. Trans Am Ophthalmol Soc. 2005;103:200-7.

Poinoosawmy D, Fontana L, Wu JX, Bunce CV, Hitchings RA.Frequency of asymmetric visual field defects in normal-tension and high-tension glaucoma. Ophthalmology. 1998;105(6):988-991.

Volpe NJ, Dadvand L, Kim SK, Maguire MG, Ying GS, Moster ML, Galetta SL.Computerized binocular pupillography of the swinging flashlight test detects afferent pupillary defects. Curr Eye Res. 2009;34(7):606-613.

Volpe NJ, Plotkin ES, Maguire MG, Hariprasad R, Galetta SL. Portable pupillography of the swinging flashlight test to detect afferent pupillary defects. Ophthalmology. 2000;107(10):1913-21.

Contact Information

See Konan Medical USA, Inc. ARVO exhibit: Booth 800

CWS and AC are employees of Konan Medical. APT, DS, TK, and NJV have no relevant conflicts of interest

Angelo P. Tanna, MD
Department of Ophthalmology
Northwestern University Feinberg School of Medicine
645 N. Michigan Ave., Suite 440
Chicago, IL 60611
atanna@northwestern.edu