Long-Term Follow-Up of Ocular Hypertension: A Plea for Peripheral Visual Field Analysis

Author's Details:
[(1)]**Paul Rutkowski, MD**-Ophthalmologist, 282 Harison Ave., Harrison, NY, USA
[(2)]**Christian Albrecht May, MD, PhD**-Department of Anatomy, TU Dresden, Dresden, Germany

Abstract
This case report demonstrates the effect of the peripheral visual field analysis in the management of ocular hypertension (OHT) and early glaucoma. For 17 years, a young Caucasian male with untreated OHT showed no abnormal responses during testing of his central visual field. Five years ago a peripheral visual field test revealed a marked loss beyond the expected age-related changes demonstrating an early peripheral visual field loss of glaucoma. The intraocular pressure was lowered with continuous medication over 5 years, and this leads to an improvement of his peripheral visual field loss. The peripheral Humphrey visual field 60-4 threshold test appears to be a valuable tool to diagnosis early glaucoma in OHT-suspects without apparent central visual field loss.
Key words*: peripheral visual field, Humphrey visual field analysis 60-4, ocular hypertension, early glaucoma*

Introduction

Ocular hypertension (OHT) is one of the risk factors for glaucoma, but OHT can persist for a long time without leading to glaucomatous damage. Routine check-ups are necessary to detect early changes requiring medical therapy to prevent irreversible vision loss. Automated static perimetry (Humphrey Visual Field Analyzer, HVF) was introduced in the 1990's as an early diagnostic and reliable instrument,[1] but due to the time and attention required for performing this test other instruments (e.g. optic nerve head or optic nerve fiber layer analysis) are in favor today.[2] They are based on the common dictum that structural changes in the optic nerve head preceded visual field loss.[3]

Lowering the intraocular pressure (IOP) in OHT mitigates the glaucomatous damage in some individuals [4] but long-term treatment can affect the quality of life.[5] It would be best to ascertain if certain individuals with presumed OHT are in fact patients harboring early glaucoma.

In a recent study, dramatic changes in the peripheral visual field during aging were described [6] that must be considered when using the peripheral visual field analyzer to determine early glaucomatous damage.[7] This case study demonstrates that both qualitative and quantitative evaluation of the the central and peripheral visual field were necessary to make an early diagnosis of glaucoma in a patient with presumed OHT who was receiving no medical therapy. It is assumed that by using the nasal component of the HVF 60-4, one can define a subgroup of presumed OHT that have early glaucoma and who would benefit from treatment.

Case description

The 50 year old Caucasian male reported here is tall, slim and very athletic spending 45 minutes 3 times a week swimming, bicycling or jogging. His job requires sitting in front of a computer screen which he interrupts several times a day to visit clients in the city. He is otherwise healthy on no systemic medications and both his father and paternal grandfather had a history of glaucoma.

One and a half weeks prior to his first consultation in 1994 an air tonometer screening test revealed elevated IOP (right eye/left eye) of 27/25 mmHg in the morning and 25/21 mmHg in the afternoon. On his initial office visit, 04/05/1994 his IOPs were 22/22 mmHg in the afternoon; gonioscopy demonstrated open angles, the cup/disc ratios were 0.5 in both eyes, refractions were -1.50 in both eyes with corrected visual acuity 20/20 in each eye. On June 06/04/1994 the IOPs were 23/23 mmHg in the morning. The thickness of the central cornea was 610/616 µm (right eye/left eye).

His IOPs ranged over the ensuing 17 years from a high (right eye/left eye) 28/26 mmHg to a low 21/20 mmHg on no treatment. Central visual field measurements HVF 30-2 were performed on 04/1997, 06/2000 and

03/2005 (figure 1); HVF 24-2 was performed 04/2008, and 04/2010. A combined HVF 24-2 and 60-4 were performed 10/2011, 05/2014 and 08/2016 (figure 2). A Heidelberg Retina Tomography was performed in September 2006, October 2011, and August 2016: all parameters were stable; borderline temporal rim parameters were temporally in the right, and less pronounced temporally in the left eye. The glaucoma probability score was within normal limits.

In October 2011 an additional peripheral visual field measurement (HVF 60-4) revealed severe peripheral visual field defects (figure 2a). These defects appeared as patchy areas in all quadrants. In the temporal quadrant of the right eye, the horizontal raphe was distinctly involved. As this involvement of the horizontal raphe had not been seen during our study of the aging peripheral visual field, therapy was initiated with a prostaglandin, Lumigan, 1 drop four times a day. This medication initially caused a decrease in IOPs to 15 mmHg in each eye. There was a gradual increase subsequently to 20mmHg in both eyes. Peripheral visual field measurements on treatment three and five years later (figure 2b and 2c) demonstrated a recovery of some visual field defects mainly in the regions between 30 and 45 degrees and along the horizontal raphe. The more peripheral regions anterior to the equator showed changes comparable with advanced aging. Quantification of the visual field measurements resulting from the sum scores of the visual field threshold of the four quadrants i.e. superior-nasal, superior-temporal, inferior-temporal, and inferior-nasal confirmed the stability of the central visual field during the years of observation. It also demonstrated improvement of both, central and peripheral visual fields after the onset of IOP-lowering medication (figure 3).

Discussion

In this case report, the peripheral visual field HVF 60-4 was examined in a patient with longstanding (17 years) of untreated ocular hypertension. Whereas the central visual field (HVF 24-2) and the Heidelberg Retina Tomography remained normal during these 17 years the introduction of the HVF-60-4 demonstrated not only profound loss of retinal ganglion cells in the ora watershed zone but also along the horizontal raphe of his right eye. Although normal aging involves peripheral field loss involving the ora watershed zone, the horizontal raphe is not involved in the 10^{th} decade of life.[6] The fact that these visual field changes occurred in a 45-year-old patient implies that both the pronounced visual field loss in the ora watershed zone and the horizontal raphe were caused mainly by the longstanding OHT. Treatment of the OHT caused improvement of both the peripheral and central visual field.

Performing an HVF 60-4 requires time and patience, but it is assumed that it could add important information to help distinguish between OHT with early stage glaucoma, demanding adequate treatment, or OHT, requiring only observation. Since early nasal defects are frequent in glaucoma,[8-12] further studies might clarify if a nasal hemi-field test combining the modified 60-4 and 30-2 HVF is both the treatment of choice and a sufficient timesaving option.

Bibliography:

1. Katz J, Tielsch JM, Quigley HA, et al. Automated perimetry detects visual field loss before manual Goldmann Perimetry. *Ophthalmology* 1995;102:21-26.
2. Schrems-Hoesl LM, Schrems WA, Laemmer R, et al. Confocal Laser Scanning Tomography to Predict Visual Field Conversion in Patients With Ocular Hypertension and Early Glaucoma. *J Glaucoma* 2016;25:371-6.
3. Öhnell H, Heijl A, Brenner L, et al. Structural and Functional Progression in the Early Manifest Glaucoma Trial. *Ophthalmology* 2016;123:1173-1180.
4. Kass MA, Heuer DK, Higginbotham EJ, et al. The Ocular Hypertension Treatment Study: a randomized trial determines that topical ocular hypotensive medication delays or prevents the onset of primary open-angle glaucoma. *Arch Ophthalmol* 2002;120:701-713.
5. Quaranta L, Riva I, Gerardi C, et al. Quality of Life in Glaucoma: A Review of the Literature. *Adv Ther*. 2016;33:959-981.

6. Rutkowski P, May CA. The Peripheral and Central Humphrey Visual Field – Morphological Changes during Aging. 2017 submitted
7. Odden JL, Mihailovic A, Boland MV, et al. Evaluation of Central and Peripheral Visual Field Concordance in Glaucoma. *Invest Ophthalmol Vis Sci* 2016;57:2797-2804.
8. Zingirian M, Calabria G, Gandolfo E. The nasal step in normal and glaucomatous visual fields. *Can J Ophthalmol* 1979;14:88-94.
9. de Oliveira Rassi M, Shields MB. Crowding of the peripheral nasal isopters in glaucoma. *Am J Ophthalmol* 1982;94:4-10.
10. Caprioli J, Spaeth GL. Static threshold examination of the peripheral nasal visual field in glaucoma. *Arch Ophthalmol* 1985;103:1150-1154.
11. Westcott MC, Garway-Heath DF, Fitzke FW, et al. Use of high spatial resolution perimetry to identify scotomata not apparent with conventional perimetry in the nasal field of glaucomatous subjects. *Br J Ophthalmol* 2002;86:761-766.
12. Nazemi PP, Fink W, Sadun AA, et al. Early detection of glaucoma by means of a novel 3D computer-automated visual field test. *Br J Ophthalmol* 2007;91:1331-1336.

Figure 1. Central (HVF 30-2) visual fields showing no pathological changes during the first decade of OHT observation (OS = left eye; OD = right eye).

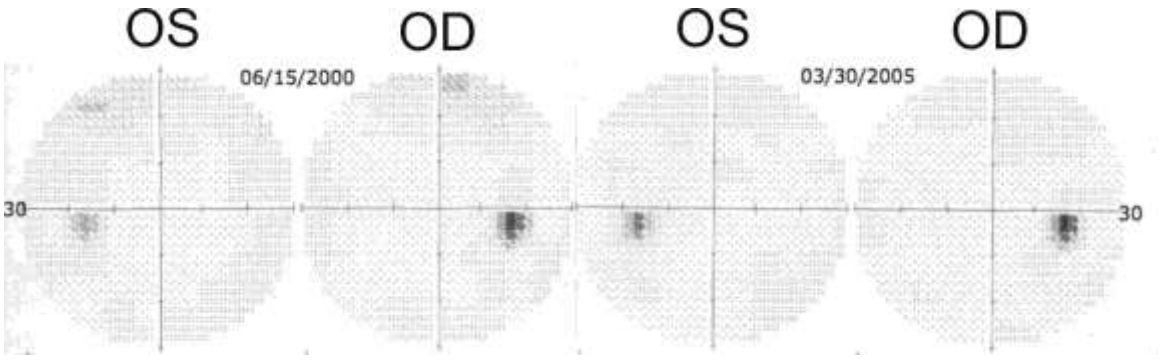

Figure 2. HVF 24-2 (outer graphs) and HVF 60-4 (inner graphs) visual field measurements of the left (OS) and right (OD) eye at age 45 (A), 48 (B)and 50 (C) years. A. Note the patchy areas of visual field defects in the upper nasal quadrants of both eyes. The marked loss of RGCs along the horizontal raphe in the right eye is pathognomonic for glaucoma. C. Although the most peripheral visual field shows a pronounced loss of ganglion cells, a recovery is seen in the HVF 60-4, pronounced in the left eye.

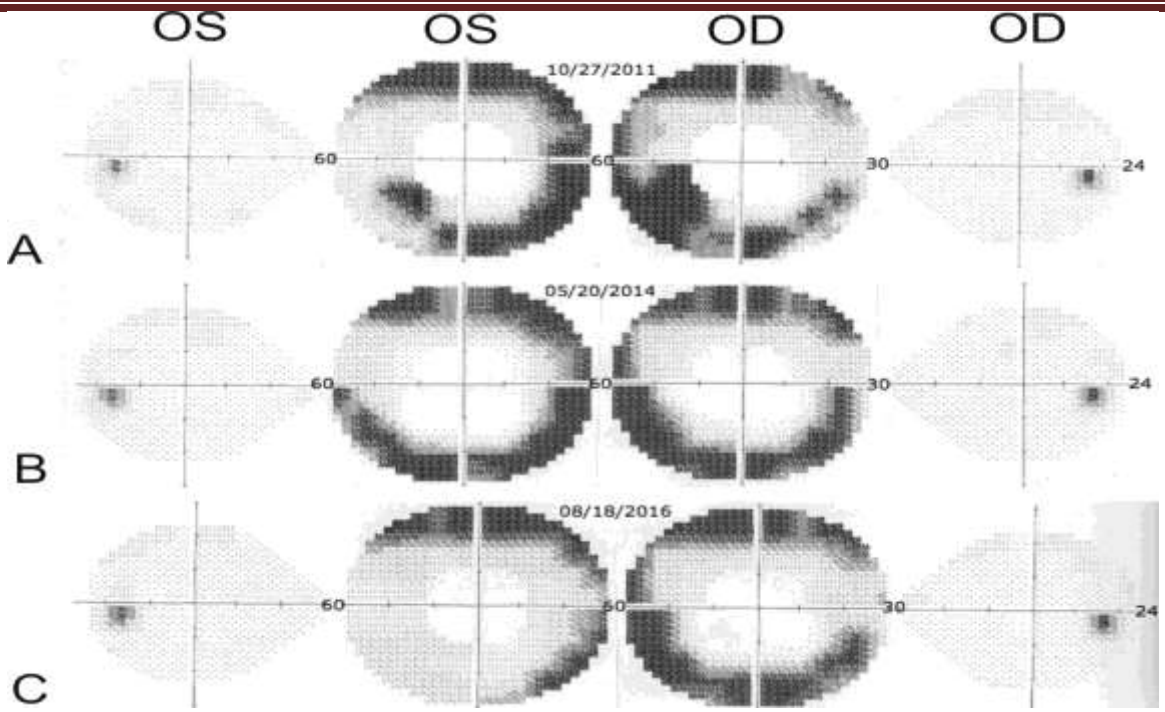

Figure 3. Quantitative central (HVF 24-2) and nasal peripheral retinal (HVF 60-4) retinal sensitivities sum scores of the visual field threshold. Ns = nasal-superior, Ni = nasal-inferior, Ts = temporal superior, Ti = temporal inferior. Intraocular pressures (IOP) are presented for the right/left eye; A = measurements a.m., P = measurements p.m. The red numbers show the improving retinal sensitivities on IOP-lowering medication.

		AGE	28	30	34	38	41	43	45	48	50
		DATE	09/29/94	04/02/97	06/15/00	03/30/05	04/15/08	04/27/10	10/27/11	05/20/14	08/18/16
right eye (24-2)	Ns		435	428	434	448	430	446	438	450	451
	Ni		431	435	439	451	455	448	449	455	459
	Ts		395	375	385	395	392	398	396	397	403
	Ti		359	362	366	376	389	386	381	393	388
left eye	Ns		413	412	371	408	392	408	405	407	407
	Ni		435	423	388	389	415	396	393	407	404
	Ts		403	388	423	434	418	439	439	443	450
	Ti		399	406	424	434	446	460	452	464	464
right eye (60-4)	Ns								178	213	193
	Ni								93	105	156
left eye	Ns								133	149	208
	Ni								111	136	301
		IOP	23/23mmA 23/22mmP	28/24mmA 23/21mmP	21/15mmA	23/21mmA	22/20mmA	25/24mmA	24/25mmA rx 15/15mmA 12/13/11	20/20mmA	20/20mmA