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Original Article

Pattern Electroretinography in Unilateral Non-Glaucomatous Pseudoexfoliation Patients

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Abstract *- Aims: To study the effect of pseudoexfoliation on electrophysiological responses of the retina in the absence of glaucoma. Methods and Material: 20 patients with exfoliations apparent in one eye only and no glaucomatous optic disc and\or visual field changes were studied using pattern electroretinography. The two eyes were examined simultaneously. P50 amplitude and peak time, N95 amplitude and peak time, and P50-N95 amplitude were compared in both eyes. Results: mean P50 amplitude and time were 1.38 µV and 57.39 ms in PXS eyes and 1.50 µV and 58.08 ms in fellow eyes, respectively (p 0.620, 0.409). Mean N95 amplitude and time were -1.68 µV and 103.11 ms in PXS eyes and -1.95 µV and 106.47 ms in fellow eyes, respectively (p 0.429, 0.219). While P50-N95 amplitude was 3.06 µV in PXS eyes and 3.45 µV in fellow eyes (p 0.04). Conclusion: Pattern ERG P50 – N95 amplitude was lower in the non-glaucomatous eye with pseudoexfoliation compared to the fellow eye, so pseudoexfoliation –even without glaucoma- can affect retinal ganglion cells response, which may be considered an early sign of a possible ganglion cells injury and eventually glaucoma.*

Keywords *- Pseudoexfoliation, Pattern ERG, Glaucoma, Visual field, Ganglion cells.*

1. Introduction

Pseudoexfoliation (PXS) is a systemic disease that affects different organs, including the eyes. It appears as a tiny white substance on many anterior chamber structures, particularly crystalline lens surface and\or pupillary edge. Pseudoexfoliation is more common in Scandinavian and Mediterranean countries. It affects one or both eyes of old people. [1,2]

These exfoliates accumulate in different ocular structures, including the anterior chamber angle, which may cause elevated intraocular pressure (IOP) and, eventually, glaucomatous optic disc injury. However, PXS patients may have a thinner retinal nerve fiber layer with normal IOP due to structural changes related to exfoliation. PXS is the leading cause of secondary open-angle glaucoma, and early diagnosis of glaucomatous injury is crucial.[3]

There are several methods to detect glaucomatous injury, divided into functional tests like visual field and electroretinography (ERG) and structural tests like ocular coherence tomography (OCT).

Visual field testing is the golden standard for detecting glaucoma, and it was the only test used for diagnosing glaucoma for a long time. However, a reduction of at least 25% of the retinal ganglion cell complex is required to produce a corresponding statistical abnormality on automated perimetry. [4]

Pattern ERG (PERG) is an objective test used to measure ganglion cell function, which is particularly affected in glaucoma. Many studies found that PERG was affected prior to the visual field, even in glaucoma suspects. [5]

No study was found in the literature comparing PERG to visual field in PXS patients, so this study aimed to compare these two tests in non-glaucomatous PXS patients**.**

2. Materials and Methods

In this cross-sectional comparative study, 20 patients studied from August 2022 to August 2023 who have unilateral PXS with no glaucomatous signs on either optic disc examination or visual field and intraocular pressure < 21 mmhg with the difference between both eyes < 5 mmhg. PXS was diagnosed with slit lamp examination when exfoliates were seen on the pupillary edge and\or anterior surface of crystalline lens. Patients were informed about the details of the study, and all participants signed an informed consent form prior to their participation. The study was conducted in accordance with the principles of the Helsinki Declaration.

2.1. Study Groups

Group 1 included the eyes with pseudoexfoliation (20 eyes), while Group 2 included the other eyes (20 eyes).

2.2. Study Methods

A medical history was taken of all patients, and visual acuity without and with correction was assessed. Ocular structures were examined using a slit lamp with biomicroscopy and gonioscopy and a goldman applanation tonometer at two different times was used to measure intra-ocular pressure.

2.2.1. Visual Field Testing

The visual field was evaluated using an Octopus 900 field analyzer (Haag Striet, Switzerland) with glaucoma 30-2 program, with false positive and false negative values under 30% and fixation loss under 20% considered reliable.MD was within normal limits.

2.2.2. Pattern Electroretinography Testing

Each patient had both eyes tested using Pattern ERG. The machine used was Retimax (CSO, Italy). The examined subject sat at 115 cm distance from 43 43-inch display to show a black-white reversing checker-stimulus in a half-lit room at the rate of 3 hertz (6 reversals\s), wearing correcting glasses suitable for examination distance. Active electrodes were HK loop type placed in the conjunctival fornix. Ground electrodes were attached to the ipsilateral lateral canthus, and the common electrode was placed on the forehead. The monitor screen covered 48˚ of the visual field with each check size of 1.8˚ visual angle. Subjects were told to look at the center of the screen with minimal blinking eye and head movement. The response consisted of a negative N35 wave followed by a positive P50, then a second negative N95 wave. Data analyzed were P50 amplitude and peak time, N95 amplitude and peak time, and P50-N95 amplitude. The P50 amplitude is measured from the trough of N35 to the peak of P50; the N95 amplitude is measured from the peak of P50 to the trough of N95. Latency measurements (peak time) should be taken from the onset of the stimulus to the peak of the component concerned

2.2.3. Exclusion Criteria

Any opacities in refractive media, the spherical equivalent of refractive error of >6 diopters, a story of ocular surgery, any ocular pathology that affects vision like diabetic retinopathy, age-related macular degeneration, visual field MD more than 2 or any focal or diffuse scotoma may be related to glaucoma.

2.3. Statistical Analysis

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 23 (IBM, Chicago, USA). Independent samples T-test was used to compare means between study groups. P value of ⩽0.05 was used as a cut off value for the significance of the results.

3. Results and Discussion

Mean intra-ocular pressure was 18.1 mmhg in PXS eyes and 15.1 mmhg in fellow eyes. Most of the participants were females (Table 1).

Table 1. Number and percentage of participants

	Number	Percentage
Males	6	30%
Females	14	70%

Age ranged between 51 and 87 years (mean 66.50). (table 2)

Table 2. Age distribution of participants

	50 – 60 years	60 – 70 years	70 – 80 years	> 80 years
Number	2	5	7	6
Percentage	10%	25%	35%	30%

There was no statistically significant difference in either P50 amplitude (1.38±1.08, 1.49 ± 0.84), P50 time (57.39 ± 3.86, 58.08 ±4.95), N95 amplitude (-1.68 ± 1.04, -1.94 ± 0.75) or N95 time (103.11 ± 14.72, 106.47 ± 10.51) between PXS and fellow eyes, respectively. However, there was a statistically significant difference in P50-N95 amplitude (3.06 ± 1.46, 3.45 ± 1.47) between both groups (p=0.04). (table 3)

4. Discussion

Pattern electroretinography is an objective test used to measure retinal response to a black-and-white checker reversing stimulus, particularly ganglion cells response. While more commonly used tests like visual field and OCT can detect glaucoma, pattern ERG may detect it earlier.

In this study, pattern electroretinography was used to examine non-glaucomatous PXS patients to study the effect of exfoliations on the retina and its ganglion cells.

Table 3. PERG parameters comparison between PXS and fellow eyes

	PXS* eye		Fellow eye		T-test**	Sig***
	Mean	SD	Mean	SD		
P50 amplitude (μV)	1.38	1.08	1.49	0.84	-0.503	0.62
P50 time (ms)	57.39	3.86	58.08	4.95	-0.845	0.409
N95 amplitude (μV)	-1.68	1.04	-1.94	0.75	0.808	0.429
N95 time (ms)	103.11	14.72	106.47	10.51	-1.272	0.219
P50-N95 amplitude (μV)	3.06	1.46	3.45	1.47	-3.084	0.04

*PXS: pseudoexfoliation syndrome; **T test: independant samples T test; ***sig: significance value p<0.05;

Pseudoexfoliation is an important risk factor for developing glaucoma in affected eyes. It is known that pseudoexfoliation glaucoma develops due to elevated intra-ocular pressure secondary to occlusion at the level of trabecular meshwork by accumulation of exfoliates. However, there are other etiologies for developing PXG, like the abnormal structure of the extraocular matrix in the optic nerve, the presence of exfoliates in optic nerve feeding vessels endothelium, and an increase in lamina cribrosa curvature. [6] This can make a conclusion that glaucoma in PXS has reasons other than elevated IOP. So 20 patients with unilateral PXS were studied with PERG, who have normal IOP, normal visual field, and normal optic disc appearance. The aim of the study was to detect early changes in ganglion cell function in PXS patients who have normal IOP and visual field using PERG, which may mean a greater possibility of developing glaucoma. This study found no significant difference in P50 or N95 parameters between PXS and fellow eyes. However, a significant difference was found in P50-N95 amplitude between the two eyes.

No study was found in the literature about PERG in pseudoexfoliation patients. However, some authors compared the two eyes of unilateral PXS patients using other tests. Yuksel et al. Used optical coherence tomography (OCT) device to measure retinal nerve fiber layer (RNFL) thickness in 22 patients with unilateral non-glaucomatous PXS and compared PXS with fellow eyes and controls, and found decreased thickness in PXS eyes compared to fellow eye and controls, while no difference was found between fellow eyes and controls. Ascertaining the other than IOP-etiologies of glaucomatous injury. [7]

In regard to PERG in non-glaucomatous eyes with risk factors for glaucoma. Demir et al. found an alteration in amplitude and time of P50 and N95 in primary open-angle glaucoma (POAG) and ocular hypertension (OHT) compared to controls, with no significant difference between the OHT group and POAG group. So they found that PERG can discover early ganglion cell dysfunction prior to visual field defects, however, it did not find a difference in PERG between early and more advanced glaucoma. [8]

Jafarzadehpour et al. studied twenty glaucoma suspects (glaucomatous optic disc appearance), 15 early POAG patients (based on abnormal discs and abnormal visual fields) and 16 normal controls, and found increased N95 peak time both in glaucoma suspects and early POAG; N95 amplitude reduction was present only in early POAG. [9]

Bode et al. studied one hundred twenty eyes of 64 patients suspected of glaucoma, with intraocular pressure greater than 25 mmhg (or ≥ 23 mmhg with additional risk factors), normal visual fields, normal optic disc appearance, and visual acuity ≥ 0.8. He found that PERG, especially the PERG ratio, detected glaucoma patients 4 years before visual field changes occurred, with a sensitivity/specificity of 75%/76% respectively. [10]

This study, in comparison with the mentioned study [8,9], did not find a difference in P50 and N95 peak time. We think this was due to the short nervous path between measuring electrodes, making alteration of time hard to detect.

This study used PERG to test ganglion cell function in non-glaucomatous PXS patients. Here, the patients are neither OHT patients nor glaucoma suspects but rather have a risk factor for developing glaucoma, which is the presence of exfoliates on anterior chamber structures, to find out whether PXS could be considered as an early glaucoma or a glaucoma suspicion. The significant reduction in P50-N95 amplitudes in the PXS eye compared to the fellow eye is a clue of disturbed ganglion cell function. What could be considered as a sign of possible early glaucoma, requiring close follow-ups or maybe IOP lowering drops.

5. Conclusion

The affected eye in unilateral non-glaucomatous PXS has sub-normal PERG compared to the fellow eye, with normal perimetry in both eyes, so pattern ERG can detect early glaucoma when perimetry is still normal.

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References

[1] S. Tuteja, M. Zeppieri, and H. Chawla, “Pseudoexfoliation Syndrome and Glaucoma,” 2021. [Google Scholar] [Publisher Link]

[2] Pasquale Plateroti et al., “Pseudoexfoliation Syndrome and Pseudoexfoliation Glaucoma: A Review of the Literature with Updates on Surgical Management,” *Journal of Ophthalmology*, 2015. [CrossRef] [Google Scholar] [Publisher Link]

[3] M, Roth, and D.L. Epstein, “Exfoliation Syndrome,” *American Journal of Ophthalmology*, vol. 89, no. 4, pp. 477-481, 1980. [CrossRef] [Google Scholar] [Publisher Link]

[4] Lisa A. Kerrigan–Baumrind et al., “Number of Ganglion Cells in Glaucoma Eyes Compared with Threshold Visual Field Tests in the Same Persons,” *Investigative Ophthalmology & Visual Science*, vol. 41, no. 3, pp. 741-748, 2000. [Google Scholar] [Publisher Link]

[5] André Carvalho Kreuz et al., "The Role of Pattern-Reversal Electroretinography in the Diagnosis of Glaucoma," *Arquivos Brasileiros de Oftalmologia*, vol. 77, no. 6, pp. 403-410, 2014. [CrossRef] [Google Scholar] [Publisher Link]

[6] F. Grehn, and Eugen Gramer, *Pex Material and Intraocular Pressure*, Pathogenesis and Risk Factors of Glaucoma, pp. 185-188, 1997.

[7] Nurşen Yüksel et al., "Analysis of Retinal Nerve Fiber Layer Thickness in Patients with Pseudoexfoliation Syndrome Using Optical Coherence Tomography," *Ophthalmologica*, vol. 221, no. 5, pp. 299-304, 2007. [CrossRef] [Google Scholar] [Publisher Link]

[8] Turkey Eman et al., "Role of Pattern Electroretinogram in Ocular Hypertension and Early Glaucoma," *Journal of Glaucoma*, vol. 28, no. 10, pp. 871-877, 2019. [CrossRef] [Google Scholar] [Publisher Link]

[9] Ebrahim Jafarzadehpour et al., "Pattern Electroretinography in Glaucoma Suspects and Early Primary Open Angle Glaucoma," *Journal of Ophthalmic & Vision Research*, vol. 8, no. 3, pp. 199-206, 2013. [Google Scholar] [Publisher Link]

[10] Sebastian F.N. Bode, Thomas Jehle, and Michael Bach, "Pattern Electroretinogram in Glaucoma Suspects: New Findings from a Longitudinal Study," *Investigative Ophthalmology & Visual Science*, vol. 52, no. 7, pp. 4300-4306, 2011. [CrossRef] [Google Scholar] [Publisher Link]