Steady-state pattern electroretinogram following long term unilateral administration of timolol to ocular hypertensive subjects

RONIT NESHER, GARY L. TRICK, MICHAEL A. KASS & MAE O. GORDON
Department of Ophthalmology and Visual Science, Box 8096, Washington University School of Medicine, 660 South Euclid Avenue, St Louis, MO 63110, USA

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Abstract. To determine whether long-term reduction of intraocular pressure leads to a corresponding preservation of the pattern electroretinogram (PERG), PERGs were studied in 21 patients with ocular hypertension who had received unilateral timolol therapy for a minimum of 6 years. The mean difference in intraocular pressure (IOP) between the placebo-treated and the timolol-treated eyes (over 6 years) was 2.4 mm Hg. Steady-state PERGs (16.0 rps) were obtained simultaneously in both eyes of each patient, with four check sizes (0.25, 0.5, 1.0 and 2.0 degrees). Significant (p < 0.05) steady-state PERG deficits (i.e., amplitude more than two standard deviations below the mean value of age-matched controls) were observed in 16 eyes of 12 patients (10 placebo-treated and 6 timolol-treated eyes). The mean PERG amplitude did not differ significantly between the placebo-treated and timolol-treated eyes. However, a significant correlation (r = -0.423) in the IOP differences between the placebo-treated and timolol-treated eyes and the corresponding PERG amplitude differences was noted in three of the four test conditions (i.e. 0.25, 0.5, and 1.0 degrees). These results suggest that reducing IOP may preserve ganglion cell function in some patients with ocular hypertension.

Abbreviations: IOP – intraocular pressure; PERG – pattern electroretinogram

Introduction

First described in 1964 [1], the pattern electroretinogram (PERG) is a bioelectrical potential generated in the inner retinal layers which largely

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represents ganglion cell function [2, 3]. PERG amplitude is significantly decreased in patients with primary open angle glaucoma as well as in some individuals with ocular hypertension [4–7]. In addition, PERG abnormalities precede optic disc damage in monkeys with laser-induced glaucoma, providing an early indication of ganglion cell damage [8]. In glaucoma patients abnormal PERGs have been observed under both transient (low temporal frequency) and steady-state (high temporal frequency) stimulus conditions, although there is some evidence that the magnitude of the PERG reduction is greater at higher temporal frequencies [9]. PERG amplitude reductions have been associated with marked elevations of intraocular pressure (> 40 mm Hg) in individual patients [10], but in a larger group of ocular hypertensives with less extreme intraocular pressure (IOP) elevations, Trick and associates [11] were unable to detect any significant correlation between IOP and PERG amplitude.

Current management of primary open-angle glaucoma is aimed at reducing IOP either medically or surgically. Since elevated IOP is a major risk factor for the development of glaucoma, a few investigators [12, 13] recently studied the therapeutic benefit of IOP reduction for preventing the development of visual field defects and progressive optic disk cupping in ocular hypertensive patients. Between 1981 and 1988 a prospective study of the effect of unilateral medical therapy on the development of glaucomatous damage in patients with ocular hypertension was carried out in the Department of Ophthalmology and Visual Sciences at Washington University. Timolol (0.25% or 0.5%), a topical nonselective beta adrenergic antagonist, served as the pressure-reducing agent. This treatment produced an IOP asymmetry that was maintained for at least 6 years. We therefore sought to investigate whether a corresponding PERG asymmetry would be detected in the patients with ocular hypertension who participated in that study. In particular we hoped to be able to define more precisely the relationship between IOP level and PERG amplitude in these patients.

**Materials and methods**

The 21 patients in our study were a subset of the group of ocular-hypertensive patients who took part in a long-term unilateral timolol treatment study which examined the efficacy of treatment on the development of open-angle glaucoma [12]. Each of the patients entering the long-term study had (a) elevated intraocular pressure (IOP) in both eyes (24 mm Hg < IOP < 35 mm Hg) at baseline, with no more than a 3-mm Hg difference in IOP between the eyes, (b) visual acuity 20/40 or better in each eye, (c) normal