

Electroretinographic Profile in Emmetropic Singaporean Eyes

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ABSTRACT

Objectives: To characterise the electroretinographic (ERG) profile in 70 Singaporean emmetropic eyes.

Method: Seventy eyes of thirty-five patients with refractive error of -1.00D or less and with a normal ophthalmic examination were chosen. They were subjected to three flash patterns generated with a Nihon-Kohden Flash Stimulator. The results were captured on a Nihon-Kohden Neuropack 8.

Results: The mean age of the patients was 25 years (range 20 to 30). The mean spherical refractive error was -0.3D (range 0D to -1.00D). For the scotopic dim flash, the mean amplitude for the 'b' wave was $304.6 \pm 69.2\mu\text{v}$ (range $175\mu\text{v}$ to $469\mu\text{v}$) and the mean latency was $47.56 \pm 4.87\text{ms}$ (range 41.2ms to 62.0ms). For the scotopic bright flash, the mean amplitude for the 'b' wave was $469.54 \pm 127.15\mu\text{v}$ (range $257\mu\text{v}$ to $750\mu\text{v}$) and the mean latency was $40.54 \pm 3.91\text{ms}$ (range 32.0ms to 48.9ms). In the flicker response, the mean amplitude for the 'b' wave was $34.19 \pm 12.97\mu\text{v}$ (range $14\mu\text{v}$ to $64\mu\text{v}$) with mean latency at $34.46 \pm 0.58\text{ms}$ (range 33.1ms to 35.9ms).

Conclusion: With ERG normal values so generated, comparisons with these can then be made for abnormal cases.

Keywords: retina, electroretinogram, nyctalopia, rods, cones

INTRODUCTION

The electroretinographic (ERG) response depends on the mass electrical response of the retina to a flash of light. Based on the pattern of ERG produced, global retinal problems such as rare night-blinding disorders, pigmentary dystrophies and cone dysfunction syndromes can be detected⁽¹⁾.

Numerous studies have been conducted on human eyes with pathologies⁽²⁾ but, to the authors' knowledge, none has been performed on normal human eyes in Singapore. We thus attempted to characterise the ERG profile of thirty-five normal male emmetropic eyes in Singapore.

METHODS

Study design

This study was a prospective, randomised open-ended clinical trial carried out at the Department of Ophthalmology, National University Hospital.

Patients

Seventy eyes of thirty-five patients had ERG performed following informed consent. Twenty-four patients (68%) were Chinese, 7 (20%) were Malays and 4 (12%) were Indians. Twenty (57%) patients were males and 15 (43%) were females. The mean age was 25 years (range 20 to 30). Inclusion criteria were: 1) age 35 or younger; 2) best corrected visual acuity of 6/9 or better in both eyes with stable refraction; 3) myopia of -1.00D or lower, and 4) normal ophthalmic examination. Exclusion criteria were: 1) complaints of poor night vision; 2) family history of night blindness, and 3) abnormal colour vision.

Pre-ERG procedure

A Nihon-Kohden Neuropack 8 Evoked Potential Measuring System Model MEB-4200 was used together with a Nihon Kohden Flash Stimulator SLS-3100 and ERG contact lens electrodes (KE-L, KE-S) (Fig 1) for the procedure⁽³⁾. The method for ERG recordings was almost identical to that of Gouras et al⁽⁴⁾.

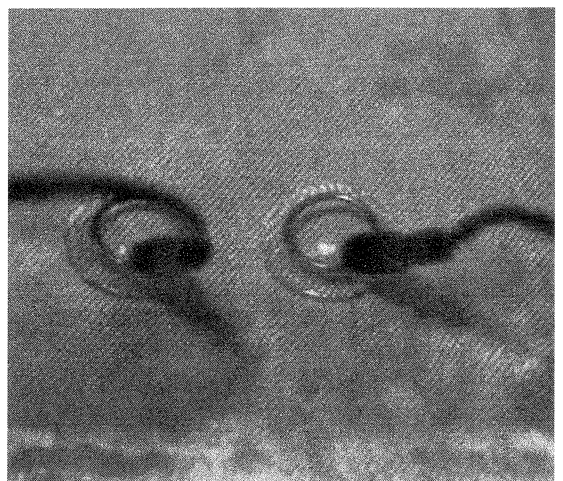


Fig 1 - ERG contact lens electrodes.

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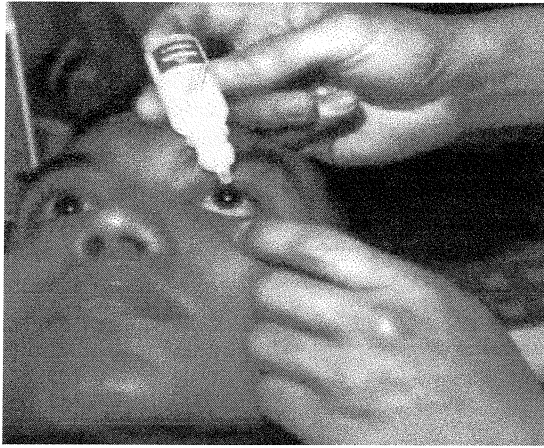


Fig 2 – Pupillary dilatation.



Fig 3 – Reference electrode.

Pre-operative examinations included: 1) detailed ophthalmic and systemic history; 2) uncorrected and best-corrected visual acuity; 3) refraction; 4) slitlamp biomicroscopy, and 5) indirect fundoscopic examination.

The patients' eyes were maximally dilated (Fig 2) with 1% Tropicamide eye drops and then dark adapted in total darkness in a room 3.4m x 3.4m for 30 minutes. The procedure was also explained to the patients.

ERG Procedure

After instillation of Amethocaine 0.5% eye drops, contact lens electrodes were placed over each cornea. An electrode each was also placed on the subjects' forehead (Fig 3), 2 cm above the glabella, as a reference electrode and on the left ear-lobe as an earth electrode. Conducting jelly ensured good contact between the skin and the electrodes⁽⁵⁾. Three types of flashes were used for the generation of the ERGs. The patients were first exposed to a scotopic dim flash at a frequency of 0.3Hz. After obtaining a satisfactorily stable waveform, the patients rested for about a minute before they were exposed to scotopic bright flash. These flashes were presented to the patients with intervals of at least 30 seconds between successive flashes. Having obtained stable waveforms, the final flash was a scotopic flicker at a rate of 30Hz. The time-base of the oscilloscope was set at 10ms/div and the sensitivity was 100 μ v/div.

Post-ERG procedure

After the ERG, results were analysed and amplitudes and latencies were recorded and stored on a disk.

RESULTS

Amplitudes and latencies for each response were determined. The latency was measured from the onset of the light stimulus to the peak of the respective wave. The amplitude of the 'b' wave was measured from the trough of the 'a' wave to the peak of the 'b' wave⁽⁶⁾.

The age range of our subjects was 20 to 30 with a mean age of 25 years. Twenty (57%) patients were males and 15 (43%) were females. The range of refraction was 0D to -1.00D with a mean refraction of -0.3D.

Scotopic dim flash

For the scotopic dim flash (Fig 4), the range of amplitudes for the 'b' wave was 175 μ v to 469 μ v. The mean was 304.6 \pm 69.2 μ v. The range of latencies was 41.2ms to 62.0ms. The mean was 47.56 \pm 4.87ms.

Scotopic bright flash

For the scotopic bright flash (Fig 5), the range of amplitudes for the 'b' wave was 257 μ v to 750 μ v. The mean was 469.54 \pm 127.15 μ v. The range of latencies was 32.0ms to 48.9ms. The mean was 40.54 \pm 3.91ms.

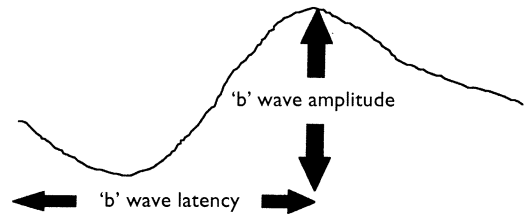


Fig 4 – Scotopic dim flash.

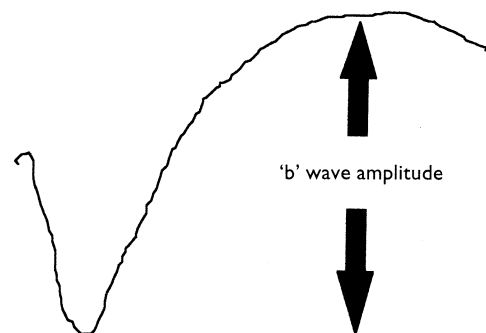


Fig 5 – Scotopic bright flash.

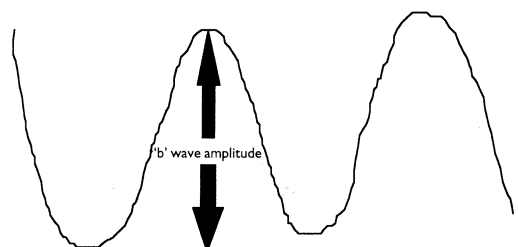


Fig 6 – Scotopic flicker.

Table I – Results of the 70 eyes

	Scotopic dim flash amplitude / μv	Scotopic dim flash latency /ms	Scotopic bright flash amplitude / μv	Scotopic bright flash latency /ms	Flicker amplitude / μv	Flicker latency /ms
Mean	304.6	47.56	469.54	40.54	34.19	34.46
SD	69.2	4.87	127.15	3.91	12.97	0.58

Table II – Results of Chinese eyes

	Scotopic dim flash amplitude / μv	Scotopic dim flash latency /ms	Scotopic bright flash amplitude / μv	Scotopic bright flash latency /ms	Flicker amplitude / μv	Flicker latency /ms
Mean	299.1	48.02	459.2	40.5	34.65	34.49
SD	70.79	5.57	135.3	3.8	12.9	0.57

Table III – Results of Malay eyes

	Scotopic dim flash amplitude / μv	Scotopic dim flash latency /ms	Scotopic bright flash amplitude / μv	Scotopic bright flash latency /ms	Flicker amplitude / μv	Flicker latency /ms
Mean	322.8	47.5	509.6	40.4	34.1	34.35
SD	49.9	2.52	102.53	4.71	13.1	0.57

Table IV – Results of Indian eyes

	Scotopic dim flash amplitude / μv	Scotopic dim flash latency /ms	Scotopic bright flash amplitude / μv	Scotopic bright flash latency /ms	Flicker amplitude / μv	Flicker latency /ms
Mean	305.4	44.9	411	41.1	31.6	34.48
SD	89.7	2.26	186.5	3.52	14.66	0.67

Table V – Results of Male eyes

	Scotopic dim flash amplitude / μv	Scotopic dim flash latency /ms	Scotopic bright flash amplitude / μv	Scotopic bright flash latency /ms	Flicker amplitude / μv	Flicker latency /ms
Mean	298.4	47.34	467.1	39.9	34.1	34.4
SD	70.8	4.87	126.46	4.27	14.32	0.54

Table VI – Results of Female eyes

	Scotopic dim flash amplitude / μv	Scotopic dim flash latency /ms	Scotopic bright flash amplitude / μv	Scotopic bright flash latency /ms	Flicker amplitude / μv	Flicker latency /ms
Mean	312.8	47.86	472.9	41.32	34.24	34.54
SD	67.2	4.95	130.1	3.26	11.16	0.63

Scotopic flicker

For the flicker (Fig 6), the range of amplitudes for the 'b' wave was $14\mu\text{v}$ to $64\mu\text{v}$. The mean was $34.19 \pm 12.97\mu\text{v}$. The range of latencies was 33.1ms to 35.9ms. The mean was $34.46 \pm 0.58\text{ms}$.

DISCUSSION

The results of our study are similar to those of Jacobi et al⁽⁶⁾. It thus shows that the ERG profile is independent of race. We have, however, used only three types of flashes whereas Jacobi used five. As different laboratories rarely use exactly the same recording equipment or procedures, it is recommended that each laboratory establish a range of normal values for each response⁽⁶⁾. It is also important that pre-ERG and ERG procedures be consistent and adhered to for every patient in order for results to be comparable to the normals so measured. Only then can ERG results be meaningful to the clinician.

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