

Photopic 30 Hz flicker ERG as a predictor for rubeosis in central retinal vein occlusion

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Abstract

Aims—To investigate the predictive value of the cone b-wave implicit time in the photopic compared with the scotopic 30 Hz flicker ERG for rubeosis in central retinal vein occlusion.

Methods—44 patients with a central retinal vein occlusion were examined with full field electroretinogram (ERG).

Results—The average implicit time in the photopic 30 Hz flicker ERG in patients who developed rubeosis (n=15) was 38.3 ms. In the patients who did not develop rubeosis (n=29) it was 31.3. The difference is statistically significant (p=0.000000004).

Conclusion—The photopic cone b-wave implicit time in the 30 Hz flicker ERG is a good predictor for rubeosis.

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The classification of central retinal vein occlusion is mainly determined by the extent of retinal non-perfusion in fluorescein angiography.^{1 2} This makes it possible to classify central retinal vein occlusion into two distinct entities depending on the amount of retinal non-perfusion—the ischaemic form and the non-ischaemic form. The two types of central retinal vein occlusion have a quite different prognosis.³ About 20–36% of the central retinal vein occlusions are ischaemic,^{4 5} and the majority of patients in this group develop rubeosis.^{4 6} It is important to identify these patients at an early stage, so that they can be followed at short intervals, in order to be able to detect early rubeosis and treat them before they develop neovascular glaucoma.

An electroretinogram (ERG) is a non-invasive examination that was introduced in 1945 by Karpe as a possible prognostic marker in patients with central retinal vein occlusion.⁷

Since then others have demonstrated that different parameters of the ERG can be helpful in distinguishing between the ischaemic and the non-ischaemic forms of central retinal vein occlusion.^{8–21}

It has previously been shown that the scotopic 30 Hz flicker ERG is a good predictor for rubeosis in central retinal vein occlusion.^{11–15}

We wanted to investigate whether the less time consuming photopic 30 Hz flicker ERG was a good predictor for rubeosis and to compare it with the scotopic 30 Hz flicker ERG, when the patients had been dark adapted for 40 minutes.

Patients and methods

PATIENTS

Forty four consecutive patients with a central retinal vein occlusion were included in the study. Patients ranged in age from 29 to 93 (mean 71.3 years); 24 patients were women and 20 were men. The time between onset of the symptoms of central retinal vein occlusion and the ERG examinations was 1–25 weeks (average 7 weeks). The follow up period ranged from 10 months to 48 months (average 25.2 months)

METHODS

ERG

Full field electroretinograms were recorded in a Nicolet Viking analysis system (Nicolet Biomedical Instruments, Madison, WI, USA), as described previously.²² After dilatation of the pupil with topical phenylephrine (10%) and cyclopentolate (1%), a Burian-Allen bipolar contact lens ERG was applied on the topically anaesthetised cornea together with a ground electrode on the forehead. The patients were dark adapted 40 minutes before the testing. Dark adapted cone responses were obtained with 30 Hz flickering white light (0.81 cd/s/m²) averaged from 20 sweeps. The implicit time was measured from the stimulus to the peak of the response (Fig 1). The referred luminances of the different light stimuli were measured on the light reflected from the Ganzfeld sphere.

Light adapted responses (background light 5 flx), after previous stimulation and 5 minutes of light adaptation were also obtained with 30 Hz flickering white light (0.81 cd/s/m²) averaged from 20 sweeps.

Clinical examination

At their first visit, the patients were given an ordinary undilated slit lamp examination with gonioscopy. After dilatation, biomicroscopy was also performed. The best corrected visual acuity was obtained, and the IOP was

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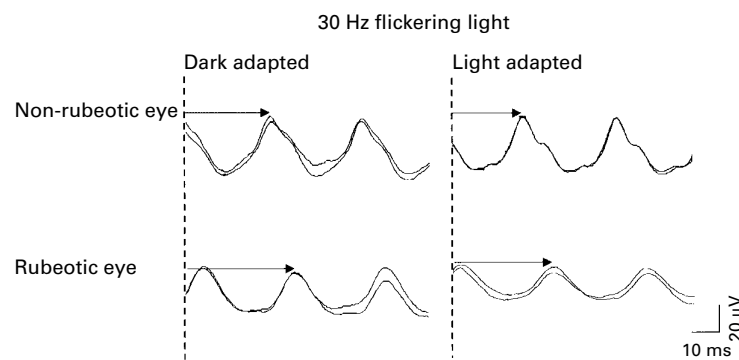


Figure 1 30 Hz flicker electroretinogram from a typical non-rubeotic eye (above) and a rubeotic eye (below) after central retinal vein occlusion. Each panel contains two averaged curves generated from 20 sweeps. The arrows demonstrate the cone b-wave implicit time in the dark adapted 30 Hz flickering ERG (left column) and light adapted 30 Hz flickering ERG (right column).

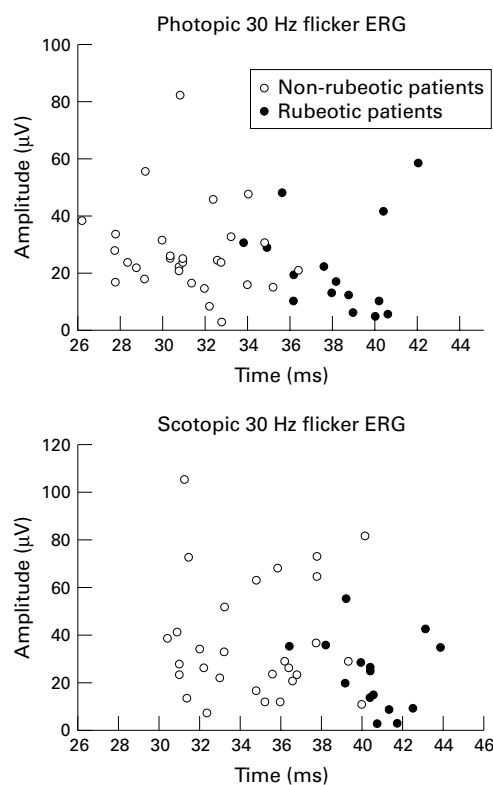


Figure 2 The b-wave implicit times and amplitudes in the photopic and the scotopic 30 Hz flicker ERG for the rubeotic and the non-rubeotic eyes.

measured. The patients were seen every second week during the first 2 months and thereafter every month.

The same examinations were done at every visit. Special care was taken to detect early rubeosis, which was defined as at least one clock hour of iris neovascularisation or any chamber angle neovascularisation. Since rubeosis or disc/retinal neovascularisation was the end point of this study, it was always confirmed by a retina specialist not taking part in the study in other respects and who had no information on the recent disease history of the patient. Patients developing rubeosis or disc/retinal neovascularisation were treated with panretinal photocoagulation.

STATISTICS

In the statistical analyses we used the unpaired two tailed Student's *t* test, since the standard deviations between the different analysed groups did not differ significantly.

Results

Of the 44 patients, 15 developed neovascular complications during the follow up period. Of these 15 patients, 10 developed rubeosis and

Table 1 The 95% confidence intervals and *p* values for the amplitudes and implicit times in the photopic and scotopic 30 Hz flicker ERG for the patients who developed rubeosis and for those that did not

	Rubeotic	Non-rubeotic	<i>p</i> Value
Photopic implicit times (ms)	36.8–39.4	29.7–32.0	0.000000004
Photopic amplitudes (µV)	12.6–33.0	21.4–33.1	0.29
Scotopic implicit times (ms)	39.5–41.6	33.5–35.8	0.000000015
Scotopic amplitudes (µV)	15.4–32.0	28.0–46.9	0.06

five neovascular proliferations on the disc. They were treated with panretinal photocoagulation. The average age in this group was 76.2 and in the non-neovascular group the average age was 68.7.

CONE B-WAVE IMPLICIT TIME IN THE 30 HZ FLICKER ERG

The average photopic b-wave implicit time in the 30 Hz flicker ERG was 38.1 ms in the patients who developed rubeosis (range 33.8–42 ms (SEM 0.61), 95% confidence limits 36.8–39.4 ms). The non-rubeotic patients had an average implicit time of 30.9 (range 22.1–36.4 ms (0.51), 95% confidence limits 29.7–32.0 ms), ($p = 0.000000004$, unpaired two tailed *t* test, considered extremely significant) (Fig 2 and Table 1).

The average scotopic b-wave implicit time in the 30 Hz flicker ERG was 40.6 ms in the patients who developed rubeosis (range 36.4–43.9 ms (0.49), 95% confidence limits 39.5–41.6 ms). The non-rubeotic patients had an average implicit time of 34.6 (range 30.4–40.2 ms (0.55), 95% confidence limits 33.5–35.8 ms), ($p = 0.000000015$, unpaired two tailed *t* test, considered extremely significant).

CONE B-WAVE AMPLITUDE IN THE 30 HZ FLICKER ERG

The average photopic b-wave amplitude in the 30 Hz flicker ERG was 21.8 µV in the patients who developed rubeosis (range 4.7–58.8 µV (4.3), 95% confidence limits 12.6–31.0 µV). The non-rubeotic patients had an average amplitude of 27.3 µV (range 2.3–82.1 µV, (2.9), 95% confidence limits 21.4–33.1 µV), ($p = 0.29$, unpaired two tailed *t* test, considered not significant).

The average scotopic b-wave amplitude in the 30 Hz flicker ERG was 23.9 µV in the patients who developed rubeosis (range 2.5–55.9 µV (4.0), 95% confidence limits 15.4–32.0 µV). The non-rubeotic patients had an average amplitude of 37.5 (range 7.1–105.5 µV (4.6), 95% confidence limits 28.0–46.9 µV), ($p = 0.06$, unpaired two tailed *t* test, considered not significant).

Discussion

Fluorescein angiography has for a long time been the standard method for assessing the degree of ischaemia in central retinal vein occlusion. There is a correlation between the degree of ischaemia and the proportion of eyes that develop rubeosis. The greater the area of ischaemia the more prone the eye is to develop rubeosis. The central retinal vein occlusion study group showed that of eyes with massive retinal ischaemia, more than 75 disc diameters of ischaemia, on fluorescein angiography only 52% developed rubeosis.²³ We have previously shown that the predictability of the ERG for rubeosis is 94%,¹⁴ which is much better than that for fluorescein angiography. Thus, ERG seems to be a better method for predicting rubeosis in central retinal vein occlusion than fluorescein angiography.

It has been known for a long time that ERG is a good predictor for rubeosis in central retinal vein occlusion. In 1945 Karpe⁷ presented the first report where a subnormal ERG was correlated with a poor prognosis for central retinal vein occlusion. After that, other investigators have confirmed his results and refined the method.⁸⁻²¹

Several ERG methods have been used, but since our previous investigation showed that the implicit time in the 30 Hz flicker ERG has the best predictive value¹³ we have therefore concentrated on these factors in this study. The basis for these finding is still unknown, but as full field cone ERG response includes the whole retina it could be suggested that a more generalised cone involvement is seen early in these patients.

A complete full field ERG examination with 40 minutes of standard dark adaptation is quite time consuming and takes about an hour to perform. A photopic 30 Hz flicker ERG only takes 5–10 minutes to perform once the pupil is dilated. Thus, it would be a great advantage to concentrate on one parameter in the ERG and still obtain the same predictability for rubeosis as for a complete ERG examination. In this study we have been able to show that the implicit time in the photopic 30 Hz flicker ERG is a very good predictor for rubeosis. Compared with the implicit time in the scotopic 30 Hz flicker ERG the photopic 30 Hz flicker ERG seems to have at least the same predictability for rubeosis in central retinal vein occlusion.

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