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=0.0000000004).

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

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 years (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. 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 fix), 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
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.

**Results**

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

**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 rubeotic and the non-rubeotic eyes.

<table>
<thead>
<tr>
<th></th>
<th>Rubeotic</th>
<th>Non-rubeotic</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photopic implicit times (ms)</td>
<td>36.8–39.4</td>
<td>29.7–32.0</td>
<td>0.0000000004</td>
</tr>
<tr>
<td>Photopic amplitudes (µV)</td>
<td>12.6–33.0</td>
<td>21.4–33.1</td>
<td>0.29</td>
</tr>
<tr>
<td>Scotopic implicit times (ms)</td>
<td>39.5–41.6</td>
<td>33.5–35.8</td>
<td>0.0000000015</td>
</tr>
<tr>
<td>Scotopic amplitudes (µV)</td>
<td>15.4–32.0</td>
<td>28.0–46.9</td>
<td>0.06</td>
</tr>
</tbody>
</table>

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 15.4–32.4 µV). The non-rubeotic patients had an average amplitude of 37.5 µV (range 21.4–33.1 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. We have previously shown that the predictability of the ERG for rubeosis is 94%, 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 Karpe 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.

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 value\(^1\) 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.

This study was supported by Kronprinsessan Margaretas arbetssnämf. Carmen och Bertil Regners stiftelse för ögonforskning and the Faculty of Medicine, Lund University Hospital.

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23. The Central Vein Occlusion Study Group. Rando-