ERG b/a Ratio and Retinal Circulation Time of CRVO

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Fourteen cases of central retinal vein occlusion (CRVO) were studied with electroretinogram (ERG) and fluorescein angiogram. The cases were divided into a venous stasis retinopathy group (VSR, 9 cases) and a hemorrhagic retinopathy group (HR, 5 cases).

The b/a ratio and retinal circulation time (RCT) were measured and compared with the control group. The mean b/a ratio of the HR group (0.86) was decreased as compared with the VSR group (1.18) and the control group (1.23). The RCT of the HR group was markedly delayed to 13.68 seconds as compared with the VSR group (11.09 sec) and the control group (6.4 sec).

These facts suggest that both the b/a ratio and the RCT are possible parameters for estimating retinal ischemia and that the ERG is a reliable examination method for classification of CRVO.

Key words: CRVO, b/a ratio, retinal circulation time.

INTRODUCTION

Since the early work by Karpe, it has been known that patients suffering from central retinal vein occlusion (CRVO) generally show a pathologically altered electroretinogram (ERG). In most cases the ERG was found to be negative or subnormal. However normal or extinguished ERG were also seen. The a-wave is generated in the receptor cells which receive blood from the choroidal vessels and the b-wave is generated from Müller cells which receive blood from the retinal vessels. So the a-wave was not affected by occlusion of the central retinal veins at least in the early stages.

Hayreh classified the CRVO by the presence or absence of retinal ischemia and called them venous stasis retinopathy (VSR) and hemorrhagic retinopathy (HR). Retinal ischemia induced a decrease of b-wave amplitude. Studies to determine the correlation between the degree of retinal ischemia and the b-wave amplitude, and the visual prognosis were performed but the b-wave amplitude had only a limited value to determine the degree of retinal ischemia. Generally the prognosis was worse with a negative, subnormal and extinguished ERG. The visual acuity dose not parallel ERG completely because a minor hemorrhage in the macula seriously affects visual acuity.

The aim of the present investigation is to determine, in the acute phase of the disease, the degree of ischemia using an ERG b/a ratio. Additionally the usefulness of retinal circulation time as a probable parameter for estimation of the retinal ischemia is studied.

MATERIALS AND METHODS

Fourteen cases of CRVO were studied. Nine were female and five were male, and the age ranged from 37 to 79 years with a mean of 52.3 years. All patients were subjected to a routine eye ex-
amination, angiography and ERG within 5 days.

ERG was recorded after dark adaptation for 10 minutes with full dilated pupils. Stimulation was done using parabolic flashlamp (Model 5013, Life-Tech), and the intensity of the light was 20 J 30 cm above the cornea. A contact lens electrode was used as an active electrode and a gold cup electrode as a reference electrode. Amplification and recording were done using Life-Tech Model 5402A and Model 5102 VISULAB system. The b/a ratio of the fellow eye was regarded as a control value.

The retinal circulation time (RCT) was defined as the interval between the first appearance of fluorescein in the central retinal artery and the filling of the vein on the optic disc. The control value of the RCT was checked in 15 eyes of central serous choroidopathy.

Final visual acuities were checked 4 to 6 months after onset.

RESULTS

b/a ratio of CRVO (Table 1)

The b/a ratio of the HR group was significantly decreased, 0.86±0.23, as compared with the control group, 1.23±0.18 (p < 0.01). But the VSR group had no significant difference with the control group.

Table 1. b/a ratio of CRVO

<table>
<thead>
<tr>
<th>Classification</th>
<th>No. of eyes</th>
<th>b/a ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>14</td>
<td>1.23±0.18</td>
</tr>
<tr>
<td>VSR</td>
<td>9</td>
<td>1.18±0.17</td>
</tr>
<tr>
<td>HR</td>
<td>5</td>
<td>0.86±0.23</td>
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RCT of CRVO (Table 2)

The RCT of CRVO was markedly delayed in both the VSR group and the HR group as compared with the control group (p < 0.01). The RCT of the HR group (13.68±0.98) was longer than the VSR group (11.09±1.21) (p < 0.05).

Table 2. RCT of CRVO

<table>
<thead>
<tr>
<th>Classification</th>
<th>No. of eyes</th>
<th>RCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>14</td>
<td>6.41±0.21</td>
</tr>
<tr>
<td>VSR</td>
<td>9</td>
<td>11.09±1.21</td>
</tr>
<tr>
<td>HR</td>
<td>5</td>
<td>13.68±0.98</td>
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Final visual acuity of CRVO (Figs. 1 & 2)

The final visual acuity of the HR group was extremely poor and the VSR group was good. The low b/a ratio group showed relatively poor visual prognosis but no close relation was noted in RCT and the visual prognosis.

Fig. 1. Correlation between the b/a ratio and the final visual acuity.

Fig. 2. Correlation between the RCT and the final visual acuity.
Case 1 (VSR)

A 57-year-old male patient visited the OPD because of reduced vision developed one day prior to the visit. Visual acuity was 0.2 (n.c.) in the right and 1.0 in the left eye. Ophthalmoscopically tortuous and dilated retinal vein, and a few small retinal hemorrhages were noted. Fluorescein angiography revealed no non-perfusion area (Fig. 3). The b/a ratio was 1.22 (Fig. 3). The patient received a urokinase treatment and 5 months after onset, vision was improved to 1.0.

![Fluorescein angiogram and the ERG of Case 1. The b/a ratio was 1.22.](image)

Case 2 (HR)

A 43 year old female patient visited the OPD because of loss of vision in her right eye which had developed 3 days prior to the visit. The visual acuity of the right eye was HM (n.c.). Ophthalmoscopically tortuous and dilated veins, and marked retinal hemorrhages were noted. An angiogram revealed a capillary non-perfusion area (Fig.4) and the RCT was 14.5 seconds. ERG showed subnormal pattern and the b/a ratio was 0.45 (Fig.4). The patient was treated with urokinase, protease and panretinal photocoagulation, however no improvement in vision was noted.

![Fluorescein angiogram and the ERG of Case 2. The b/a ratio was 0.45.](image)

DISCUSSION

In 1945, Karpe[1] first described the alterations of the ERG in CRVO and provided prognostical conclusions for final vision. Nilsson[6] studied the quantitative correlation between the b-wave amplitude and the retinal circulatory disturbance. But comparison of the absolute amplitude of the b-wave had limited diagnostic value because of its large variations. Based on the fact that the receptor cells are not affected by retinal vascular disturbances, at least in acute phases, the a-wave is normally recorded in CRVO. So the degree of ischemic damage to the inner retinal layer can be presented by the amplitude ratio of the a- and b- wave. The b/a ratio of the HR group, which was classified by angiographic findings, was lower than the VSR group and the control group. Of the 5 HR group cases, only one case showed a b/a ratio over 1.0. Ishikawa[9] noted that the cases which presented a b/a ratio
over 1.0 had a final visual acuity over 0.6. In the present study, all of the HR group exhibited a final visual acuity under 0.05 in spite of a b/a ratio over 1.0. That case revealed a thick macular hemorrhage on initial examination and macular degeneration at the time of the final visual acuity check. In the VSR group, only one case presented a b/a ratio under 1.0. But this case showed a b/a ratio of 0.97 in the fellow eye. All of the cases of the VSR group had a final visual acuity over 0.5. These facts suggest that comparison of the b/a ratio with the normal fellow eye is a useful method for prognostic conclusions. But in the HR group, the visual prognosis were very poor even though the b/a ratios ranged from 0.45 to 1.15. Sometimes reduced a-wave amplitudes were noted and this could be due to the fact that hemorrhages and/or edema accompanying retinal vascular obstruction could spread to the receptor layer, causing damage in turn. In the present study, a reduced a-wave was not recorded and this may be due to the fact that the ERG was checked in the acute phase.

Retinal circulation time is one of the parameters of retinal blood flow dynamics. Nilsson defined it as the time interval between the first appearance of fluorescein in the retinal arteries and the first appearance of fluorescein as a laminar flow along the walls of the retinal vein. But practically, to detect the first venous laminar flow is more subjective than to detect the venous filling of the optic disc. So in this study, the RCT was measured from the first appearance of fluorescein in the retinal artery to the venous filling of the optic disc. The RCT of the HR group ranged from 12.2 to 14.8 seconds but no relationship with final visual acuity was noted. In the VSR group, the range of the RCT was greater than in the HR group. Two cases presented RCT under 10 seconds. These were the cases of hsemi-CRVO of Hayreh.

REFERENCES