Effect of optical coherence tomography (OCT) in assessing the prognosis of central serous choriorretinopathy

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ABSTRACT

Objective: To study the effect of optical coherence tomography (OCT) in assessing the prognosis of central serous choriorretinopathy. Methods: 100 cases of central serous choriorretinopathy patients diagnosed in our hospital from 2013 May to 2014 May were enrolled in observation group and furtherly divided into neural epithelium detachment group, pigment epithelium detachment group, neural and pigment epithelium detachment group according to FFA. 100 cases health people received healthy examination in our hospital during the same period were enrolled in control group. Then optical coherence tomography and multifocal ERG results were compared. Results: (1) optical coherence tomography: Sfct, Nct, Scct, Tct, Ict of observation group were higher than those of control group; Sfct, Nct, Scct, Tct, Ict of neural and pigment epithelium detachment group were higher than those of neural epithelium detachment group and pigment epithelium detachment group; (2) multifocal ERG: 1ring and 2 ring of P1 wave reaction density of observation group were lower than those of control group; 3ring, 4 ring, 5 ring of P1 wave reaction density of observation group had no difference with control group. Conclusion: optical coherence tomography (OCT) can accurately assay choroidal thickness of central serous choriorretinopathy and has good consistency with fundus fluorescein angiography and multifocal ERG results.

1. Introduction

Central serous choriorretinopathy (CSC) is a common ocular fundus disease in department of ophthalmology, which may involve in the macular area and is more commonly seen in young men. The characteristics of this disease are the 1-2 mm scope of choroid vascular congestion in macular area and barrier function damage of retinal pigment epithelial[1,2]. Fundus fluorescein angiography (FFA) is the most commonly used method to judge CSC disease, but it is an invasive examination, and some patients are allergic to fluorescein. So the clinical application value of FFA is limited. Optical coherence tomography (OCT) is a recently developed non-invasive, non-contact inspection method, which can accurately determine the thickness of choroid. In the following study, we analyzed the optical coherence tomography (OCT) in assessing the prognosis of retinopathy central serous choroid.

2. Objects and methods

2.1. Objects

100 cases of central serous choriorretinopathy patients diagnosed in our hospital from 2013 May to 2014 May were enrolled in observation group. All patients were consistent with the diagnosis of disease, including 56 male cases, 34 female cases, age (48.52 ± 6.25) years old. 100 cases of healthy people in our hospital for health examination during the same period were included in the control group. All subjects were healthy, including 58 male cases, 32 female cases, age (48.13 ± 6.63) years old. Two groups of patients
were all informed research matters and signed informed consents. No statistically significant difference in general data ($P>0.05$).

2.2. Methods

2.2.1. Optical coherence tomography method

The wavelength of OCT instrument was 840 nm, axial and lateral resolutions were respectively 5 μm and 10 μm, scanning speed and depth were 29 000 A/s and 2 mm respectively. After acquisition of image information, we determined the vertical distance from retinal pigment epithelium (RPE) to the the medial sclera boundaries as choroidal thickness (CT). Thickness under Choroidal central foveal (Sfct) and 1.5 mm from the fovea at 0 choroidal thickness (Nct), 90 choroidal thickness (Sct), 180 choroidal thickness (Tct), 270 choroidal thickness (Ict) were measured.

2.2.2. Analysis methods of subgroup CSC patients

CSC patients received fundus fluorescein angiography. After eliminating allergic history, they were injected 3 mL 10% fluorescein sodium through elbow vein within 5 S, and then were carried out to take fundus photography. According to the fluorescence angiography, observation group patients were further divided into three groups: (1) the neural epithelium detachment group: light reflex of central fovea of macula was abate, the edge of it had the visible arc light, punctate fluorescence were visible in the view; (2) the pigment epithelial detachment group: under the view there were patchy fluorescence; (3) neural epithelium combined pigment epithelial detachment group: under the view there were yellowish white exudate.

2.2.3. Multifocal electoretinogram examination method

ERG Version system of Germany Roland company production were used to carry out multifocal ERG. We routinely dilated their pupils before inspection. The distance of checking was 24 cm, the magnification was 100 K, the stimulator brightness was 120 cd/m$^2$, contrast was 96%, low frequency 10 Hz, high frequency 100 Hz. Reaction waves of 5 concentric circular arrangement rings with the center of the fovea were measured and then P1 wave reaction density was analyzed.

2.4. Statistical method

SPSS 18.0 software was used to input and analyze the data. Comparisons between two groups using $t$ test. Variance analysis was used to compare between three groups. The difference had statistical significance when $P<0.05$.

3. Results

3.1. OCT results of two groups of subjects

Using optical coherence tomography to measuring choroidal thickness of the two groups, including choroidal thickness of subfoveal choroidal thickness and distance from the fovea 1.5 mm 0 degrees, 90 degrees, 180 degrees, 270 degrees, the analysis was carried out by $t$ test, the patients in observation group were higher in Sfct, Nct, Sct, Tct, Ict than the healthy control group, the difference was statistically significant ($P<0.05$). This showed that choroidal thickness in patients with central serous chorioretinopathy increase.

Table 1. Comparison of OCT results of two groups of subjects.

<table>
<thead>
<tr>
<th>Group</th>
<th>Sfct (μm)</th>
<th>Nct (μm)</th>
<th>Sct (μm)</th>
<th>Tct (μm)</th>
<th>Ict (μm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation group</td>
<td>482.32±55.52</td>
<td>436.19±51.73</td>
<td>408.63±53.10</td>
<td>447.69±56.19</td>
<td>442.16±54.23</td>
</tr>
<tr>
<td>Control group</td>
<td>267.72±38.95</td>
<td>236.18±32.49</td>
<td>209.17±30.49</td>
<td>226.74±34.57</td>
<td>229.59±28.49</td>
</tr>
<tr>
<td>$T$</td>
<td>9.298</td>
<td>8.894</td>
<td>9.948</td>
<td>10.192</td>
<td>9.004</td>
</tr>
<tr>
<td>$P$</td>
<td>$&lt;0.05$</td>
<td>$&lt;0.05$</td>
<td>$&lt;0.05$</td>
<td>$&lt;0.05$</td>
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</tr>
</tbody>
</table>

3.2. Patients with different severity of CSC optical coherence tomography results

By taking fluorescence fundus angiography, patients with CSC were divided into neural epithelium detachment group, pigment epithelium detachment group, neural epithelium combined with pigment epithelial detachment group. Through variance to analysis the optical coherence tomography results further: light choroidal thicknesses in different severity of CSC patients were different ($P<0.05$), Data between two groups were compared with LSD-$t$ test. It showed that neuroepithelial with pigment epithelial detachment groups, Sfct, Nct, Sct, Tct, Ict were higher than that of the neural epithelium detachment group and the pigment epithelial detachment group, the difference was statistically significant ($P<0.05$).

Table 2. OCT results comparison of different severity of CSC patients.

<table>
<thead>
<tr>
<th>Detachment group</th>
<th>Sfct (μm)</th>
<th>Nct (μm)</th>
<th>Sct (μm)</th>
<th>Tct (μm)</th>
<th>Ict (μm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigment epithelial</td>
<td>402.32±42.39</td>
<td>415.24±49.35</td>
<td>413.63±51.34</td>
<td>422.54±55.73</td>
<td>428.52±60.57</td>
</tr>
<tr>
<td>Neural and pigment</td>
<td>596.48±71.30</td>
<td>602.47±73.52</td>
<td>584.56±67.72</td>
<td>613.38±70.46</td>
<td>620.46±76.28</td>
</tr>
<tr>
<td>$F$</td>
<td>8.928</td>
<td>9.283</td>
<td>8.138</td>
<td>8.582</td>
<td>7.392</td>
</tr>
<tr>
<td>$P$</td>
<td>$&lt;0.05$</td>
<td>$&lt;0.05$</td>
<td>$&lt;0.05$</td>
<td>$&lt;0.05$</td>
<td>$&lt;0.05$</td>
</tr>
</tbody>
</table>

3.3. The multifocal electoretinogram examination results of two groups

The visual electrophysiology of two groups of subjects were tested by multifocal electoretinogram, including the response density of P1 wave from ring-1 to ring-5, the analysis was carried out by $t$ test, the patients in observation group had a lower P1 wave reaction density than that of the control group in ring1 and ring2. The difference
was statistically significant (P<0.05); there was no differences in response density of 3 ring, 4 ring and 5 ring P1 waves (P>0.05). This meant that the P1 wave changes in patients with central serous chorioretinopathy concentrated in the 1 and 2 rings.

Table 3.
Comparison of densities of multifocal ERG reaction in P1 wave of two groups of subjects.

<table>
<thead>
<tr>
<th>Group</th>
<th>1 loop (µV/deg²)</th>
<th>2 loops (µV/deg²)</th>
<th>3 loops (µV/deg²)</th>
<th>4 loops (µV/deg²)</th>
<th>5 loops (µV/deg²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation group</td>
<td>77.72±8.38</td>
<td>63.32±6.61</td>
<td>51.54±6.23</td>
<td>42.48±5.85</td>
<td>31.18±4.31</td>
</tr>
<tr>
<td>Control group</td>
<td>154.4±9.03</td>
<td>103.4±13.42</td>
<td>55.18±6.83</td>
<td>42.6±5.02</td>
<td>32.47±4.28</td>
</tr>
<tr>
<td>T</td>
<td>12.105</td>
<td>8.592</td>
<td>0.872</td>
<td>0.482</td>
<td>0.227</td>
</tr>
<tr>
<td>P</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&gt;0.05</td>
<td>&gt;0.05</td>
<td>&gt;0.05</td>
</tr>
</tbody>
</table>

4. Discussion

Central serous chorioretinopathy (CSC) is the fundus diseases involving the macular area, the characteristics of it is serous retinal neuroepithelial layer or pigment epithelial detachment, it mainly manifests decreasing in visual acuity, blurred vision, deformation, discoloration. Pathological damage will cause irreversible damage of visual function in visual[3]. At present, the pathogenesis of central serous chorioretinopathy has not been fully elucidated. But it was agreed that choroidal vascular congestion, retinal pigment epithelial barrier function damage is the most important pathology[4]. Choroidal congestion will cause local hydrostatic pressure increasing; choroidal serous will flow into the retinal neuroepithelial layer under the stockpile through the defect leakage in retinal pigment epithelial layer, which leading to the detachment of retinal pigment epithelial layer and epithelial layer[5]. Thus it can be seen that vascular dilation and leakage in choroidal is the pathological characteristics of CSC patients. Fundus fluorescein angiography (FFA) is the main method to diagnose CSC. It can show the retinal vascular leakage point clearly and display the location and extent of vascular leakage sensitively. What is more, it also can accurate value the severity of the disease and provide evidence for the laser treatment in clinical[6]. However, FFA is an invasive examination, and a part of patients are allergies to fluorescein. What is more, FFA can not accurate reveal the thickness of retinal and choroidal, which limits the value of FFA to judge the severity of disease in a certain extent[7].

Optical coherence tomography (OCT) is a recently developed non-contact, non-invasive technique[8]. Principle of the inspection technology lies in the different tissues and structures for incident weak coherent light reflection signal or the different scattering signal. The two-dimensional or three-dimensional image of the scanning area can be obtained by detecting the signal. Then choroidal thickness can be acquired directly[9]. The inspection method has characters of high resolution, good repeatability, the penetration depth and it is not affected by the influence of basic refractive media. It can provide an objective basis to determine the condition[10,11]. This study first analyze the OCT scans of patients with central serous chorioretinopathy and healthy subjects, the results showed: the patients in the observation group were higher in Sfct, Nct, Sct, Tct, Ict than those in the control group of healthy subjects. This suggests that OCT scanning can accurately determine the thickness of the choroid. Patients with central serous chorioretinopathy exist the situation of choroidal thickening. Slurry leakage in choroidal is the key factor to cause the choroidal damage, the more severe retinal vascular leakage, the more serious damage of choroidal. FFA can show the presence of fundus vascular leakage points and provide direct evidence for the severity of disease[12]. The author analysis the OCT scan results and judge the severity of CSC patients through FFA, and finding that neuroepithelial with pigment epithelial detachment groups were higher in Sfct, Nct, Sct, Tct, Ict than that of the neural epithelium detachment group and the pigment epithelial detachment group. This means that the OCT scan can determine the severity of ocular fundus blood vessel leakage. And the neural retinal pigment epithelial detachment more serious, more obvious thickening of the choroid.

Recent studies recognize that: patients with central serous chorioretinopathy can appear visual electrophysiological changes based on choroidal damage. The distribution of retinal cone cells and rod cell determines the form of visual electrophysiology. Cone cells are mainly distributed in the macular region, and it is the highest in the fovea, reaching 1.5×10⁶/mm²; in the distance from the fovea 40 µm it decreases significantly in density. When the distance reaches 1.5 mm, its number down to 6 000/mm². Rod cells are mainly distributed away from the fovea in the retinal. At a distance of 3-5 mm, that is the annular region, it has the highest density[13]. Pathological changes of CSC patients are mainly concentrated in the macular area within a range of 1-2 mm. The thickening of the choroid leads to the region graph change and cause a series of clinical symptoms[14]. Due to there are mainly cone cells around macular 1-2 mm, the function of cone cells can also evaluate the condition of CSC. The first-order reaction of multifocal electroretinogram (mfERG) can reflect the average luminance response. Its density distribution consistent with the density distribution of the photoreceptor cells; P1 wave latency and amplitude variation is less than N1 wave, and the wave density is decreasing with the increasing of centrifugal distance, which is similar to the changes of retinal cone cells[15]. In this study, mfERG was used to detect the amplitude density of the retina, and which was regard as the change of the cone response density. The results show: 1 and 2 rings of P1 wave reaction density of the patients in the observation group was lower than that of the control group; and there is no difference in the 3 ring, 2 ring and 3 Ring P1 wave
reaction density. This means that the pathological changes of central serous chorioretinopathy concentrate in the 1 and 2 rings, which is consistent with OCT results.

Comprehensive discussed above, we can draw the conclusion: optical coherence tomography (OCT) can accurately assess choroidal thickness of the central serous chorioretinopathy, and has a good consistency with fundus fluorescein angiography and multifocal ERG results.

References


