Blood–aqueous Barrier Function in a Patient With Choroideremia

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The purpose was to determine whether there was a breakdown of the blood–aqueous barrier in a patient with choroideremia. A 27-year-old man with typical choroideremia underwent standardized ophthalmological evaluation, including quantitative measurement of aqueous flare intensity, by a laser flare-cell meter. The results showed areas of atrophy of the choriocapillaries and retinal pigment epithelium in the mid-periphery and posterior pole, although not in the macula. Fluorescein angiography showed areas of loss of the choriocapillaries and retinal pigment epithelium. The fovea was spared with a surrounding zone of hyperfluorescence. Electroretinography showed a subnormal photopic amplitude and extinguished scotopic response. Electrooculography revealed that the light peak/dark trough ratio was reduced. Goldmann perimetry showed constricted peripheral fields. Laser photometry showed an increase in the aqueous flare intensity in both eyes, as compared with normal subjects. We conclude that the function of the blood–aqueous barrier might be affected in patients with choroideremia. [J Formos Med Assoc 2010;109(2):167–171]

**Key Words:** blood–aqueous barrier, choroideremia

Mauthner1 first described choroideremia as a separate entity from retinitis pigmentosa. In 1942, Goedbloed2 and Waardenburg3 independently recognized the mode of inheritance as a sex-linked disorder, with men more markedly affected, and women only mildly affected and stationary, and proposed it as a “sex-linked intermediate form”. Krill and Archer4 further described choroideremia as “diffuse and total choroidal atrophy of X-linked inheritance” according to the pathology and fluorescein angiographic findings. Choroideremia is now well-documented as a unique, bilateral, progressive chorioretinal degenerative disease with characteristic fundus changes, night blindness, and visual field constriction.

Retinitis pigmentosa has been demonstrated to cause dysfunction of the blood–aqueous barrier.5 Here, we evaluated the function of the blood–aqueous barrier in a patient with choroideremia to determine whether this disease shows the same trends as retinitis pigmentosa.

Laser photometry provides assessment of blood–aqueous barrier function without the use of invasive techniques.6,7 We used a laser flare-cell meter to examine the status of the blood–aqueous barrier in a patient with this rare disease. This is believed to be the first report to confirm the presence of breakdown of the blood–aqueous barrier in choroideremia.

**Case Report**

In June 2006, a 27-year-old man presented with a history of night blindness since childhood. One of his cousins also had a history of night blindness.
blindness, but there was no family history of consanguinity. The patient’s past medical history was unremarkable.

Examination showed a visual acuity of 20/20 with a correction of −0.5 D in the right eye and 20/25 with a correction of −1.0 D in the left eye. Biomicroscopy showed a clear cornea and media in both eyes. An ophthalmoscopic examination showed areas of atrophy of the choriocapillaries and retinal pigment epithelium in the mid-periphery and the posterior pole, although not in the macula. The optic discs and retinal vessels were normal (Figure 1). Fluorescein angiography showed areas of loss of retinal pigment epithelium and choriocapillaries. The fovea was spared with a surrounding area of hyperfluorescence caused by the window defect (Figure 2).

Examination of color vision with the Farnsworth–Munsell 100-Hue test revealed a total error score of 228 with a deuteran orientation in the right eye, and 208 with no discernible axis in the left eye. Dark adaptation studies with the Goldmann–Weeker’s adaptometer revealed the final rod threshold was increased 0.6 log units in the right eye and 1.4 log units in the left eye. Goldmann perimetry revealed constricted peripheral fields in both eyes. Electroretinography showed subnormal photopic amplitudes and extinguished

Figure 1. Areas of atrophy of choriocapillaries and retinal pigment epithelium in the mid-periphery and posterior pole, although not in the macula: (A) right eye; (B) left eye.

Figure 2. Fluorescein angiography showing areas of loss of retinal pigment epithelium and choriocapillaries. The fovea is spared with a surrounding area of hyperfluorescence: (A) right eye; (B) left eye.
scotopic response in both eyes (Figure 3). The electrooculogram showed a light peak/dark trough ratio of 1.27 in the right eye and 1.18 in the left eye (Figure 4).

The aqueous flare intensity was measured with a laser flare-cell meter (FC 1000; Kowa, Tokyo, Japan) 30 minutes after pupillary dilation with 0.5% tropicamide and 5% phenylephrine hydrochloride. There was a marked increase in the aqueous flare values in both eyes: 11.5 ± 5.8 photon counts/msec in the right eye, and 12.3 ± 5.0 photon counts/msec in the left eye. In 10 age-matched control subjects examined in our department, the aqueous flare intensity averaged 4.32 ± 0.86 photon counts/msec.

Discussion

Choroideremia is characterized initially by the presence of pigment epithelial mottling in the mid-periphery of the retina. As the disease progresses, areas of atrophy of the choriocapillaries and retinal pigment epithelium develop in the mid-periphery and spread toward the macula and the periphery. These areas coalesce gradually and progress. The final, fully developed feature is the presence of total atrophy of the choroid, with the exception of the macula, which shows a diffuse, yellow–white reflex of the underlying sclera.8–10 Fluorescein angiography demonstrates areas of loss of retinal pigment epithelium and choriocapillaries. There might be also a relative sparing of retinal pigment epithelium and choriocapillaries in the central macular area, which demonstrates hypofluorescence that corresponds to the intact fovea, and a surrounding area of hyperfluorescence caused by the window defect.11 The ophthalmoscopic and fluorescein angiographic findings in our patient were identical to those in other studies.

Retinitis pigmentosa and other retinal diseases have been demonstrated to cause dysfunction of the blood–aqueous barrier.5,12,13 However, the function of the blood–aqueous barrier in choroideremia has not yet been determined. Many forms of indirect measurement, such as inferences from fluorescein angiography, and anterior chamber coefficients of fluorescein leakage values, have been used as indices of blood–aqueous barrier permeability.14,15 However, analysis by fluorophotometry with systemic fluorescein administration is complicated by the adverse effects of fluorescein and the rapid metabolism of the dye. Laser photometry, a recently developed diagnostic technique, makes precise, objective, and

![Figure 3](image_url)
noninvasive measurement of the function of the blood–aqueous barrier more feasible. The laser flare-cell meter consists of a He–Ne laser beam system, a photomultiplier mounted on a slit-lamp microscope and a computer. The He–Ne laser beam has a power of 50 μW and a diameter of 20 μm. The laser beam is projected into the anterior chamber, and scattering of the laser beam within a sampling window (0.3 × 0.5 mm) is detected by means of a photon-counting photomultiplier and analyzed by a computer.

To the best of our knowledge, this is the first study to estimate the function of the blood–aqueous barrier in choroideremia. The aqueous flare intensity was increased about 2.7 times in the right eye and about 2.8 times in the left eye, compared with normal values obtained from the age-matched controls. The increase in the aqueous flare intensity in this patient suggests an alteration of the blood–aqueous barrier function associated with choroideremia. The exact location of the disruption of the blood–aqueous barrier remains undetermined, but the stroma of the iris root and the iris vessels are possible sites. The changes might be mediated by increased prostaglandin and lactate dehydrogenase levels, and could also be influenced by humoral or neurogenic factors. Further study is needed to determine what kinds of biochemical mediators are associated with the breakdown of the blood–aqueous barrier function in choroideremia. Meanwhile, the proteins released by the dysfunction of the blood–retinal barrier might exert a direct effect on the vascular permeability of the anterior segment, or could diffuse anteriorly into the anterior chamber directly. It needs further histological or biochemical studies to determine whether the source of increased aqueous flare intensity results from the breakdown of the blood–aqueous barrier itself or simply from proteins diffusing from the posterior segment caused by the breakdown of the blood–retinal barrier.

References

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