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Original Article

Systolic blood pressure, choroidal thickness, and axial length in patients with myopic maculopathy

Chih-Chien Hsu [a,b], Shih-Jen Chen [a,c,*], An-Fei Li [a,c], Fenq-Lih Lee [a,c]

[a] *Department of Ophthalmology, Taipei Veterans General Hospital, Taipei, Taiwan, ROC*
[b] *Institute of Clinical Medicine, National Yang-Ming University, Taipei, Taiwan, ROC*
[c] *National Yang-Ming University School of Medicine, Taipei, Taiwan, ROC*

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Abstract

Background: In the population-based Shihpai Eye Study, patients aged >65 years with myopic maculopathy were found to have higher systolic blood pressure. This finding deserved further exploration because this is the only correctable factor for preventing maculopathy in patients with high myopia. Therefore, we investigated the association between myopic maculopathy and systolic blood pressure, as well as other ocular parameters in this study.
Methods: A clinic-based, retrospective cross-sectional study at a medical center was conducted between February 2011 and October 2012. Patients with high myopia were included and medical charts were reviewed. High myopia was defined as axial length ≥26.5 mm in at least one eye. Myopic maculopathy was defined as the presence of lacquer cracks, focal areas of deep choroidal atrophy, diffuse chorioretinal atrophy, and macular choroidal neovascularization or geographic atrophy in the presence of high myopia. Systolic blood pressure measurements were collected, and fundus photography and optical coherence tomography were performed. Subfoveal choroidal thickness (SFCT) shown on optical coherence tomography was measured and recorded.
Results: The medical records of 187 high-myopic patients (87 without and 100 with maculopathy) were reviewed. Patients with maculopathy were older (56.96 years vs. 42.95 years, $p < 0.01$), had longer axial length (29.96 mm vs. 27.31 mm, $p < 0.01$), thinner SFCT (49.71 μm vs. 155.77 μm, $p < 0.01$), higher systolic blood pressure (132.28 mmHg vs. 125.31 mmHg, $p < 0.05$), greater prevalence of hypertension (31% vs. 16%, $p < 0.05$), and longer history of hypertension (2.34 years vs. 0.59 years, $p < 0.01$) compared to patients without maculopathy. After multivariate adjustment, SFCT and axial length were the only significant factors for maculopathy.
Conclusion: Thinner SFCT and longer axial length are significant risk factors for myopic maculopathy. Unlike previous epidemiological surveys, results of this clinic-based study suggested that systolic blood pressure is not a significant factor for maculopathy.

Keywords: axial length; choroidal thickness; high myopia; hypertension; myopic maculopathy

1. Introduction

The prevalence of myopia is increasing worldwide and has become an extensive public health problem, especially in East Asian countries.[1–5] Among myopia, high myopia, also termed "pathologic myopia" or "degenerative myopia", is associated with multiple ocular morbidities. One of the most important complications of high myopia is myopic maculopathy, which often causes significant visual impairment.[6] The signs of

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* Corresponding author. Dr. Shih-Jen Chen, Department of Ophthalmology, Taipei Veterans General Hospital, 201, Section 2, Shih-Pai Road, Taipei 112, Taiwan, ROC.
E-mail address: sjchen@vghtpe.gov.tw (S.-J. Chen).

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maculopathy may include tessellated change at the posterior retina, posterior staphyloma, lacquer cracks, patchy atrophy, choroidal neovascularization (CNV), and geographic atrophy.[7] Clinic-based studies have shown that increased severity of maculopathy is associated with increased axial length and age.[8,9]

In the population-based Shihpai Eye Study, patients aged >65 years with myopic maculopathy were found to have higher systolic blood pressure after multivariate adjustment including age and other systemic factors.[10] Higher systolic blood pressure is associated with thinner choroidal thickness in normal individuals,[11,12] therefore, the authors suggested that increased systolic blood pressure may play a role in the pathogenesis of maculopathy by decreasing choroidal circulation from the back of the eye.[10] However, that study had a small sample size and important ocular parameters such as axial length and choroidal thickness were not analyzed. This finding deserved further exploration because systolic blood pressure might be the only correctable factor for preventing maculopathy in patients who already have high myopia. The purpose of the present study was to clarify the risk factors associated with myopic maculopathy in a clinic-based study with more complete data, namely systolic blood pressure, axial length, choroidal thickness, and age.

2. Methods

2.1. Patients

This was a clinic-based, retrospective cross-sectional study that reviewed the medical records of 187 highly myopic Chinese patients from February 2011 to October 2012 at the Medical Center, Taipei Veterans General Hospital, Taipei, Taiwan. The Institutional Review Board approved the protocols of this study prior to initiation. High myopia was defined as axial length $\geq$26.5 mm. Myopic maculopathy was defined as the presence of lacquer cracks, focal areas of deep choroidal atrophy, and macular CNV or geographic atrophy in the presence of high myopia.[10] When eyes of a patient were discrepant for the severity of myopic maculopathy, the more severe eye was assigned for the study. However, if the more severe eye had any retinal disorder other than myopic maculopathy or foveoschisis, or had ever received ocular surgery other than intravitreal injection and cataract surgery, the less severe eye was assigned. Eyes with macular pucker, diabetic retinopathy, age-related macular degeneration, retinal vein occlusion, retinal artery occlusion, retinal detachment, and eyes that had ever received vitrectomy and scleral buckling were excluded.

2.2. Ophthalmic examinations

Ophthalmic examinations included measurements of visual acuity with Snellen charts at a distance of 6 m, autorefraction (RK-8100; Topcon, Tokyo, Japan), non-contact tonometry (CT-60; Topcon), slit-lamp biomicroscopy (Model BQ900; Haag-Streit, Bern, Switzerland), and indirect ophthalmoscopy (Model 12500; Welch Allyn, Skaneateles Falls, NY, USA) through a dilated pupil with 1% tropicamide (Alcon, Couvreur, Puurs, Belgium). Lens status was recorded as phakic, pseudophakic, and aphakic. In addition, ultrasound biometry (AL-1000; Tomey Corporation, Aichi, Japan) was performed in all patients. Both eyes of each participant were photographed using a monoscopic fundus camera (CF-60UD; Canon, USA) at least 30 minutes after pupil dilatation. Two photographic fields were taken in each eye, with one centered at the fovea and the other at the optic disc. Optical coherence tomography (OCT) imaging of both eyes was performed using RTVue OCT (Optovue Inc., Fremont, CA, USA). Subfoveal choroidal thickness (SFCT) was measured using the calipers within the OCT machine software and positioning them from the outer aspect of Bruch's membrane to the border of the sclera.[11] With the participant in a seated position, blood pressure was measured in the right arm using an electronic sphygmomanometer (ES-P2000; Terumo, Japan) and the average of at least three measurements was recorded. History of hypertension, diabetes mellitus, stroke, and cardiovascular disease was defined as a positive medical record and treatment with medications for such conditions.

2.3. OCT imaging

RTVue OCT uses the technology of spectral-domain OCT. The scanning pattern was set to produce a cross-line scan that obtained 16 individual B scans of 1024 pixels each at the same location for a total of 16,384 data points per line. The B scan was viewed as an averaged composite image that reduced OCT noise and enhanced the image sharpness. The SFCT was measured at the center of the fovea in the horizontal and vertical line pattern (Fig. 1). The horizontal data[13] were used

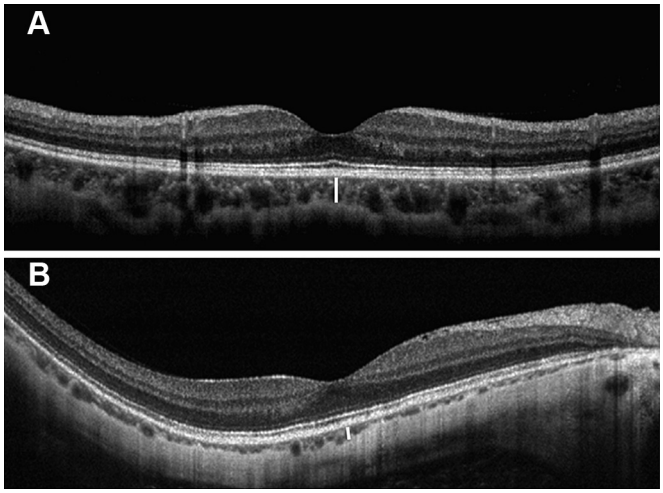

Fig. 1. SFCT is measured from Bruch's membrane to the sclera at the center of the fovea perpendicular to the Bruch's membrane plane. The image color was changed to increase the contrast between the choroid and the sclera. (A) OCT of a 32-year-old woman without maculopathy. The axial length is 26.62 mm and SFCT is 140 μm (as shown by the white line). (B) OCT of a 41-year-old man with myopic maculopathy. His axial length is 30.34 mm and SFCT is 63 μm (as shown by the white line). OCT = optical coherence tomography; SFCT = subfoveal choroidal thickness.