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Biometric indices evaluation in central retinal vein occlusion using partial coherence laser interferometry

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PURPOSE. *To evaluate the association of axial length and posterior segment length with central retinal vein occlusion (CRVO) using optical coherence interferometry.*
METHODS. *The study group consisted of 29 patients (13 female and 16 male) with unilateral CRVO who were referred to Farabi Eye Hospital. Patients with macular edema were excluded. The mean keratometry (mean K), axial lengths (AL), anterior chamber depths (ACD), and posterior segment lengths (PSL, defined by AL – ACD) of affected and fellow eyes were measured using optical coherence interferometry.*
RESULTS. *Age range was 45 to 74 years (mean 59.2 ± 7.5 years). The mean K of affected eyes was not statistically significantly lower than that of unaffected eyes in the CRVO group. This was also true for ACD. Although affected eyes had shorter axial length (23.26 mm vs 23.33 mm), the difference was not significant. There was a statistically significant difference in PSL affected and unaffected eyes (20.15 mm vs 20.26 mm) (p=0.008).*
CONCLUSIONS. *Posterior segment length of eyes with CRVO may be shorter than unaffected eyes. This may predispose them to more crowding of central retinal vein and artery in lamina cribrosa, and developing CRVO. (Eur J Ophthalmol 2007; 17: 383-7)*

KEY WORDS. *Central retinal vein occlusion, Axial length, Hyperopia, Partial coherence laser interferometry, Anterior chamber depth*

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INTRODUCTION

Retinal vein occlusion (RVO) is the second most common retinal vasculopathy after diabetic retinopathy (1). Many systemic and local factors that contribute to thrombus formation can predispose to the development of RVO, including hypertension, diabetes mellitus, hyperviscosity, hyperlipidemia, primary open angle glaucoma (POAG), and hyperopia (2, 3).
The association between hyperopic refractive error and RVO has been demonstrated (4-6). However, there is no general agreement on the role of axial length as a predisposing factor for RVO (4, 7-11). In these studies ocular axial lengths have been measured by A-scan ultrasonography. The clinical accuracy of the axial eye length measurement using conventional ultrasound biometry has been reported to be approximately 100 to 120 µm (12-14). It is affected by corneal indentation in applanation method and also by macular edema (13-15).
Recently, partial coherence laser interferometry has found its application in biometry. It has improved precision (0.3-10 µm) in axial length using the principle of partial coherence laser interferometry (13, 14, 16-18). It is also advantageous to ultrasound in patients with macular edema if

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there is residual fixation ability (15). It has been proposed that the significant difference between the affected eyes and contralateral unaffected eyes in some studies may be due to the effect of macular edema on the ocular axial length measurements (10). Thus we used partial coherence laser interferometry to measure different segments of eye.

We conducted a study in which the primary goal was to determine the role of axial length and posterior segment length in central retinal vein occlusion (CRVO) using partial coherence laser interferometry.

PATIENTS AND METHODS

Twenty-nine patients with CRVO referred to Farabi Eye Hospital between July 2004 and July 2005 were included. The mean duration of symptoms was 3.6 months (range, 1 to 6 months).

All patients underwent systemic and ocular examination, including fasting blood glucose level determination, systemic blood pressure measurement, cardiovascular examination, intraocular pressure (IOP) measurement, indirect ophthalmoscopy, gonioscopy, and fundus fluorescein angiography. Exclusion criteria were persistent macular edema (based on funduscopy and fluorescein angiography), retinal detachment, eye trauma, intraocular inflammation, tumor, or previous ocular surgery.

Apart from keratometry (Zeiss keratometer), biometric measurements were conducted with the help of IOL Master (Carl Zeiss Jena). A posterior segment length (PSL) was defined as AL minus ACD. A minimum of 10 measurements was obtained for every parameter in each eye for calculating mean values. The same person who was not aware of the eye condition performed all the measurements.

Student *t*-test was used for statistical testing and a significance level of less than 0.05 was set.

RESULTS

Patients were between 45 and 74 years old (mean 59.2 ± 7.5 years). Thirteen of the participants (44.8%) were female. Fifteen patients (51.7%) had hypertension, 7 (24.1%) had diabetes mellitus, and 1 (3.4%) had glaucoma.

Table I shows mean keratometry, AL, ACD, and PSL measurements for eyes with CRVO along with those of their fellow eyes. Although the eyes with CRVO were on average was 0.07 mm shorter than their fellow eyes, this difference did not reach statistical significance (Fig. 1). Yet data revealed that the cases with CRVO were significantly shorter in terms of their PSL than their fellow eyes (a mean difference of 0.14 mm, p=0.005) (Fig. 2).

DISCUSSION

There are several risk factors for RVO, including hypertension, diabetes mellitus, arteriosclerosis, POAG, hypermetropia, hyperlipidemia, hyperviscosity, increase in fibrinogen and coagulation factors, and deficiencies of proteins C and S (19). In this study, 51.7% of the patients had hypertension and 31.4% had diabetes mellitus, which is consistent with the previous reports in the literature (2, 3, 20).

In our study, although the mean axial length of the eyes with CRVO was shorter than the mean axial length of the unaffected fellow eyes and the control eyes, the difference was not significant between the groups. There was a statistically significant difference in PSL affected and un-

TABLE I - KERATOMETRY AND BIOMETRIC INDICES OF THE EYES WITH CENTRAL RETINAL VEIN OCCLUSION ALONG WITH THOSE OF THE FELLOW EYES

	CRVO	Fellow eye	p value*
Keratometry, diopters, mean ± SD(range)	43.9±1.4 (41.4–47.5)	43.8±1.5 (41.2–47.4)	0.2
Anterior chamber depth, mm, mean ± SD (range)	3.13±0.25 (2.59–3.58)	3.07±0.04 (2.34–3.56)	0. 69
Axial length, mm, mean ± SD (range)	23.26 ±0.33 (20.94–24.99)	23.33±0.83 (21.09–24.95)	0.69
Posterior segment length, mm, mean ± SD (range)	20.12± 0.72 (18.35–21.60)	20.26±0.66 (18.75–21.63)	0.005

*Student *t*-test

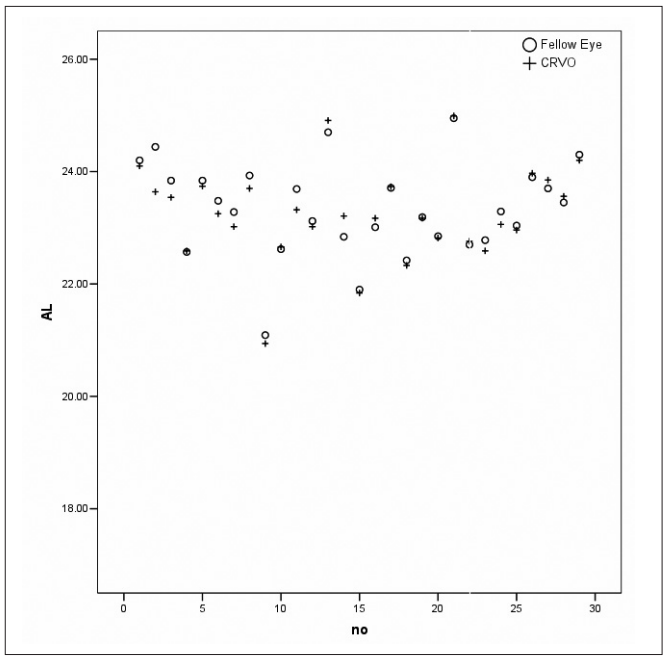

Fig. 1 - *Axial length of the eyes with central retinal vein occlusion and that of the unaffected fellow eyes.*

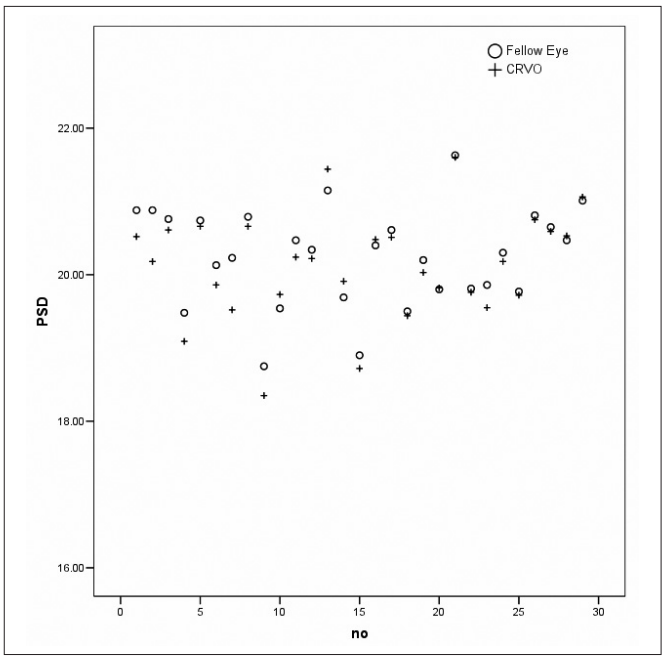

Fig. 2 - *Posterior segment length of the eyes with central retinal vein occlusion and that of the unaffected fellow eyes.*

affected eyes.

Thrombus formation had been observed at or near the lamina cribrosa in eyes with CRVO in histopathologic studies (21). Theoretically, eyes with shorter axial length as a measure of axial hypermetropia may be predisposed to greater crowding of the central retinal vein and artery at the lamina cribrosa, and are therefore more likely to develop CRVO (4).

Recently, partial coherence laser interferometry has found its application in biometry. With this approach, more accurate biometry can be performed since the technique does not require direct contact between the transducer and the eye and the cornea is therefore not indented, resulting in minor axial length shortening compared with applanation ultrasonography (12, 13). It has improved precision (0.3-10 μm) in axial length using the principle of partial coherence laser interferometry (13, 14, 16-18). It is also advantageous over ultrasound in patients with macular edema if there is residual fixation ability. Thus we used optical coherence tomography to measure different portions of eye (15).

There is no general agreement on the role of axial length as a predisposing factor for RVO (4, 7-11). Brown et al (9), Cekic et al (4), Tsai et al (8), and Shi and Chen (7) found significantly shorter axial length in affected eyes of patients with CRVO compared with control eyes. However, this difference was not observed between affected and unaffected fellow eyes. Ariturk et al reported significantly shorter axial length in affected eyes of patients with CRVO compared with both unaffected fellow eyes and control eyes (10). In addition, some studies have found significantly shorter axial length in eyes with RVO compared with control eyes (5, 10), although others did not find a difference (11, 22).

Part of the observed inconsistency in the literature could be attributed to the selection of the control group. It has been argued that the significant differences between the axial length in affected eyes and unaffected fellow eyes could be due to the effect of macular edema on the axial length measurements (10). In these studies ocular axial lengths have been measured by A-scan ultrasonography. Biometry performed by A-scan uses the echo time to measure intraocular distances (12). The clinical accuracy of conventional ultrasound in axial length measurement has been reported to be lower than partial coherence interferometry (100 to 120 μm vs 0.3 to 10 μm) (13, 14, 16-18). Measurements with conventional ultrasound are affected by corneal indentation and macular edema (12, 15).

Cekic et al (4) suggested that the ratio between axial length and area of the lamina cribrosa might explain variations in the results of the previous studies and recommended quantitative comparison of both the axial length and the area of the lamina cribrosa and comparing the differences between eyes with RVO and unaffected fellow eyes. This theory may also be supported by this study, as our cases with CRVO had shorter posterior segment length than the unaffected fellow eyes. Our data showed a significant association between shorter posterior segment length and CRVO. Reduced and altered blood flow due to narrowing of the scleral canal at the lamina cribrosa relates to the shorter posterior segment length.

There is no uniformity of risk factors in the studies of CRVO. Hyperopia as measured by axial length may not be a risk factor for CRVO if patients with macular edema are excluded. In cases in which there is a major risk factor for developing CRVO, the factor that may preferentially predispose one eye of a patient to its fellow eye could be a shorter posterior segment length. Further studies with a larger number of patients are needed to test this hypothesis.

The review board and ethical committee of Eye Research Center of Tehran University of Medical Sciences approved this study.

The authors have no conflicts of interest.

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