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Relationship between retinal vein occlusion and ocular biometric parameters

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ABSTRACT

Aims: To compare the biometric characteristics of eyes with unilateral retinal vein occlusion (RVO) with unaffected eyes of patients and eyes of healthy participants

Methods: The affected eyes (group 1) and unaffected eyes (group 2) of 57 patients with unilateral RVO and the right eyes of 57 healthy participants (group 3) were included in the study. Axial length (AL), vitreous length (VL), anterior chamber depth (ACD) and lens thickness (LT) measurements by ultrasonic biometry were retrospectively analyzed.

Results: Mean AL was 22.61±0.89 mm in group 1, 22.93±0.88 mm in group 2 and 23.10±0.90mm in group 3. Mean AL was found to be lower in group 1 compared to both group 2 and group 3 ($p<0.001$, $p=0.005$, respectively). Mean VL values were 15.28±1.11 mm in group 1, 15.36±1.44 mm in group 2, and 15.97±1.01 mm in group 3. Mean VL was statistically significantly shorter in group 1 than both group 2 and group 3 ($p=0.026$ and $p=0.001$, respectively). Mean VL was statistically significantly lower in group 2 than in group 3 ($p=0.015$). In group 1, the mean ACD was 3.02±0.41 mm, in group 2 the mean ACD was 3.15±0.50 mm, and in group 3 the mean ACD was 3.01±0.32 mm. While the mean ACD of group 1 was lower than that of group 2 ($p<0.001$), there was no statistically significant difference between group 1 and group 3 and between group 2 and group 3 ($p=0.696$ and $p=0.092$, respectively). Mean LT was similar in all groups and no statistically significant difference was found between the groups ($p>0.05$)

Conclusion: Ocular causes of RVO may include short AL and short VL.

Keywords: Retinal vein occlusion, axial length, biometry, anterior chamber

INTRODUCTION

Retinal vein occlusion (RVO) is the second most common retinal vascular disease after diabetic retinopathy and causes unilateral vision loss.[1] According to the location of the occlusion, it is classified as central retinal vein occlusion (CRVO) and branch retinal vein occlusion (BRVO).[2] A comprehensive meta-analysis showed that the prevalence of CRVO was 0.13%, the prevalence of BRVO was 0.64% and the prevalence of BRVO was 0.64% worldwide in 2015. According to these prevalence results, it was calculated that approximately 28.06 million people were affected by RVO in 2015.[3]

Although the pathophysiology of CRVO is not well understood, several hypotheses have been proposed. One hypothesis for CRVO is that the central retinal vein is compressed and thrombosed by the atherosclerotic central retinal artery at the level of the lamina cribrosa.[4] In branch retinal vein occlusion, it has been shown that the thin-walled vein traveling in the common adventitial sheath in the arterio-venous transition areas is compressed and thrombosed between the retina and the artery with increased thickness due to atherosclerosis.[5] Many ocular and systemic risk factors have been identified for the development of RVO. Systemic risk factors such as atherosclerotic heart disease, diabetes mellitus, hypertension, hematological disorders causing thrombophilia, and oral contraceptive use have been associated with RVO.[6-8] Recent studies have shown many cases of RVO secondary to coronavirus 19 disease.[9] Previous studies have shown that ocular risk factors are glaucoma, hyperopia, and short axial length (AL).[10,11] Short axial length results in a narrow scleral canal and small lamina cribrosa holes. Stasis and thrombosis develop as nerve fibers and vascular structures pass through the lamina cribrosa.

This study aimed to investigate the ocular risk factors for RVO in patients with unilateral RVO by comparing AL, anterior chamber depth (ACD), vitreous length (VL), and lens thickness (LT) measurements in the affected eye with the patients' fellow eyes and healthy participants' eyes.

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METHODS

The medical records of 57 patients who were admitted to Hitit University Ophthalmology Clinic between January 2022 and December 2023 and diagnosed with RVO were retrospectively analyzed. The study was approved by the Hitit University Non-interventional Researches Ethics Committee (Date: 05.04.2024, Decision No: 2024-08) and was conducted in accordance with the tenets of the Declaration of Helsinki. The 57 eyes of the affected patients (group 1), 57 unaffected fellow eyes (group 2), and the right eye of a healthy control group of 57 patients (group 3) were included in the study. Age, sex, presence of ocular diseases and systemic diseases such as diabetes mellitus, hypertension, and atherosclerotic heart disease that may lead to RVO were investigated and recorded.

Detailed ophthalmological examinations of the patients and the control group were performed. The diagnosis of the patients was confirmed by fundoscopic findings such as tortuous vessels, intraretinal hemorrhages, soft exudates, and fundus fluorescein angiography. A-scan ultrasonography (Nidek AL-Scan) and optical coherence tomography (Triton, Topcon Corporation, Tokyo, Japan) were performed to assess the presence of macular edema in all patients and healthy controls. Before the A-scan ultrasound measurements, local anesthetic drops (0.5% proparacaine, Alcaine, Alcon **Pharmaceuticals**, Rijksweg, Belgium) were instilled in all patients and healthy subjects, and one minute after instillation, measurements were taken with an 11 MHz contact probe, applying minimal pressure to the cornea and facing the optical axis. During the measurement, the device took 10 consecutive measurements for AL, ACD, VL, and LT in series and provided results by averaging these measurements. The measurements were compared between the eyes of the patients with RVO, the unaffected fellow eyes of the patients, and the eyes of the healthy control group.

Patients with a previous diagnosis of retinal pathology (diabetic retinopathy, age-related macular degeneration, hereditary maculopathies), patients who had been treated for RVO, patients with a history of ocular surgery, and patients who developed macular edema during the course of the disease were excluded from the study as this may affect the ultrasound measurements.

Statistical Analysis

One-sample Kolmogorov-Smirnov test was used to assess the normality of the data distribution. Parameters with normal distribution were assessed using the within-group paired samples test and the between-group independent samples test, while parameters with non-normal distribution were assessed using the within-group Wilcoxon test and the between-group Mann-Whitney U test. The Chi-squared test was used for categorical parameters. Data are presented as mean and standard deviation from this value. $p<0.05$ was considered statistically significant. SPSS ver. 25.0 was used for statistical calculations.

RESULTS

The study included 57 eyes of 57 patients with RVO (group 1), 57 unaffected fellow eyes of patients (group 2), and 57 right eyes of 57 healthy participants (group 3). The mean age was 60.73 years in the patients with RVO and 59.86 years in the healthy subjects. While 30 of the patients with RVO were male and 26 were female, 31 of the healthy participants were male and 26 were female. There was no significant statistical difference in age and gender between patients with RVO and healthy subjects ($p=0.468$ and $p=0.706$, respectively). The presence of diabetes and hypertension was assessed in all participants and no difference in the prevalence of diabetes and hypertension was found between patients with RVO and the healthy control group ($p=0.895$ and $p=0.867$, respectively) (Table 1). Among the patients with RVO, the right eye was affected in 31 patients (54.4%), and the left eye was affected in 26 patients (45.6%), and there was no difference in laterality between the eyes ($p=0.508$). Of the patients with RVO, 30 were male (52.6%) and 27 were female (47.4%) and there was no statistically significant difference between the sexes ($p=0.611$). CRVO was observed in 18 patients and BRVO in 39 patients. The upper quadrant was involved in 28 patients and the lower quadrant was involved in 11 patients with BRVO.

Table 1. Demographic data of the patient and control group

	Patient group	Control group	p
Age	60.73±9.75	59.86±9.89	0.468
Gender (male/famele)	30/27	31/26	0.706
Diabetes mellitus, no (%)	19 (33.3%)	17 (29.8%)	0.895
Hypertension, no (%)	28 (49.12%)	29 (50.87%)	0.867

The mean AL was 22.61±0.89 mm in group 1, 22.93±0.88 mm in group 2, and 23.10±0.90 mm in group 3. The mean AL was lower in group 1 than group 2 and group 3 ($p<0.001$, $p=0.005$ respectively). There was no statistically significant difference in mean AL between group 2 and group 3 ($p=0.322$) (Figure 1).

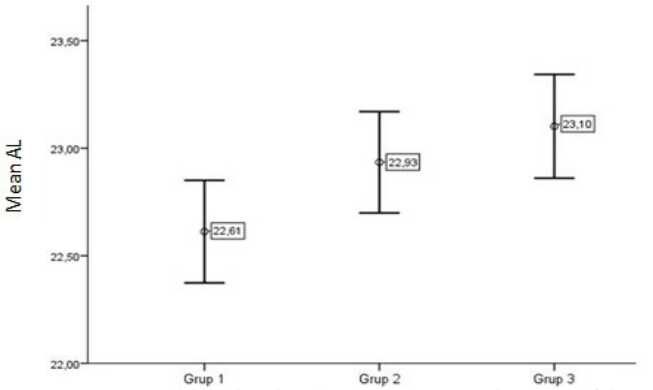

Figure 1. Mean axial length values between groups with 95% confidence interval

AL: Axial length

The mean VL was 15.28±1.11 mm in group 1, 15.36±1.44 mm in group 2, and 15.97±1.01 mm in group 3. The mean VL was statistically significantly shorter in group 1 than in group 2 and group 3 ($p=0.026$ and $p=0.001$, respectively). When comparing unaffected eyes, the mean VL was statistically significantly shorter in group 2 than in group 3 ($p=0.015$) (Figure 2).

The mean LT was 4.30±0.78 mm in group 1, 4.39±0.65 mm in group 2, and 4.26±0.68 mm in group 3. The mean LT was similar in all three groups and no statistically significant difference was observed in pairwise group comparisons ($p>0.05$).

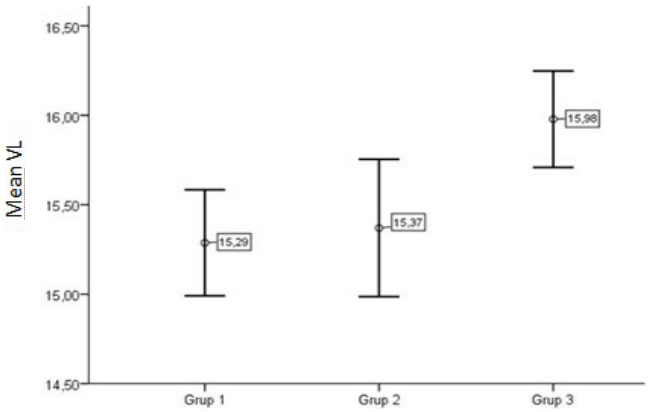

Figure 2. Mean vitreous length values between groups with 95% confidence interval

VL: Vitreous length

The mean ACD was 3.02±0.41 mm in group 1, 3.15±0.50 mm in group 2, and 3.01±0.32 mm in group 3. The mean ACD of group 1 was statistically significantly lower than group 2 (p<0.001). However, there was no significant statistical between group 1 and group 3 and between group 2 and group 3 (p=0.696 and p=0.092, respectively) (Table 2).

DISCUSSION

RVO is a globally prevalent disease leading to visual loss. The epidemiology of the disease has been investigated in previous population-based studies and large meta-analyses. The prevalence of RVO was 0.7% in females and 0.6% in males (p=0.59), while the prevalence of CRVO was 0.1% in females and 0.2% in males (p=0.71) in the Beaver Dam eye study published by Klein et al.[12] In this study, no statistically significant difference was found between right and left eyes in patients with RVO (p=0.72). The prevalence of RVO was 1.6% in both men and women in the study by Mitchell et al.[13] using data from the Blue Mountains eye study. In our study, there was no significant statistical difference in gender and laterality in patients with RVO (p=0.508 and p=0.611, respectively).

Although systemic hypertension, older age, atherosclerosis, and diabetes mellitus have been shown in previous studies as risk factors for RVO, mechanical factors are also thought to play a role in the pathophysiology of the disease.[2] Previous studies have shown that short AL measurements may be a risk factor for RVO. Ghoghari et al.[15] reported that the mean AL of the affected eyes of 35 patients with RVO was 0.80 mm shorter than the mean AL of 35 eyes of the healthy control group (p=0.01). Szigeti et al.[16] studied the affected eyes of 40 patients with RVO, unaffected fellow eyes, and the right eyes of 40 healthy subjects. Mean AL was 22.99±0.56 mm in eyes with RVO, 23.09±0.51 mm in unaffected fellow eyes, and 23.48±0.68 mm in healthy subjects' eyes. While the mean AL of the healthy subjects' eyes was found to be statistically significantly higher than both the eyes with RVO and the fellow eyes (p=0.001 and p=0.005, respectively), no statistically significant difference in AL was found between the eyes with RVO and fellow eyes of the patients (p=0.052). Another study by Çiloğlu et al.[17] compared 49 patients with CRVO, 71 patients with BRVO, and healthy subjects. While there was no statistically significant difference in AL between the eyes with CRVO and BRVO and the unaffected fellow eyes of the patients (p=0.064 and p=0.104, respectively), the mean AL of the eyes of the healthy subjects was significantly higher than the AL of the eyes affected by CRVO and BRVO (p=0.0001 and p=0.0004, respectively). There are also studies in the literature with different results. Vural et al.[18] found that the mean AL of 31 eyes with CRVO was 23.14±0.86 mm, the mean AL of 42 eyes with BRVO was 23.24±0.82 mm, and the mean AL of 41 healthy eyes in the control group was 23.38±0.87 mm, and there was no statistically significant difference between the groups (p=0.460). Longo et al.[19] analyzed 39 eyes of patients with CRVO, the patients' fellow eyes, and the eyes of 39 healthy subjects and found no statistically significant difference in AL between the groups (p=0.069). In our study, the mean AL was 22.61±0.89 mm in eyes with RVO (group 1), 22.93±0.88 mm in the unaffected fellow eyes (group 2), and 23.10±0.90 mm in the eyes of the healthy participants (group 3). The mean AL was statistically significantly lower in group 1 than in group 2 and group 3 (p<0.001, p=0.005, respectively). There was no statistically significant difference in mean AL between group 2 and group 3 (p=0.322). These results suggest that RVO may be caused not only by systemic diseases but also by ocular effects. In the short AL, the flow in the retinal vein is slowed down due to the narrowing of the lamina cribrosa and the scleral canal through which the retinal vein and the retinal artery pass. It has been suggested that this slowing of blood flow may predispose to thrombus formation in areas of arteriovenous compromise with narrowing of the venous lumen.[20] This study showed that AL has statistically effect on RVO. However, it is difficult to show that this difference is clinically significant and has a cut-off value.

Szigeti et al.[16] reported that VL values in the eyes of patients with RVO were significantly lower than both the patients' fellow eyes and the eyes of healthy subjects (p<0.001). There was no significant difference in VL between healthy and fellow eyes (p=0.709). In our study, group 1 was significantly shorter than group 2 and 3 in mean VL (p=0.026 and p=0.001 respectively) and, group 2 was significantly lower than group 3 in mean VL (p=0.015).

The relationship between RVO and ACD has also been investigated in previous studies. Wu et al.[21] reported that the mean ACD in the eyes with CRVO of 24 patients was 2.43±0.45 mm and the mean ACD of the fellow eyes was 2.55±0.46 mm (p<0.001). Coşkun et al.[11] analyzed the eyes of 25 patients with RVO, the fellow eyes of 25 patients,

Table 2. Comparison of biometric values of the groups

	Group 1	Group 2	Group 3	p group1 vs group 2	p group 1 vs group 3	p group 2 vs group 3
AL	22.61±0.89	22.93±0.88	23.10±0.90	<0.001	0.005	0.322
VL	15.28±1.11	15.36±1.44	15.97±1.01	0.026	0.001	0.015
LT	4.30±0.78	4.39±0.65	4.26±0.68	0.349	0.863	0.402
ACD	3.02±0.41	3.15±0.50	3.01±0.32	<0.001	0.696	0.092

AL: Axial length, VL: Vitreus length, LT: Lens thicknes, ACD: Anterior chamber depth

and the eyes of 26 healthy subjects. The ACD was higher in the control group than in the eyes with RVO and in the fellow eyes (p<0.001). There was no statistically significant difference between the fellow eyes of the patients and the eyes with RVO (p=0.918). Contradictory results have been reported. The studies by Vural et al.[18] and Szigeti et al.[16] found no statistically significant difference in ACD between the eyes of patients with RVO, fellow eyes of patients and the eyes of the control group. In our study, the mean ACD of Group 1 was statistically significantly lower than group 2 (p<0.001). No statistically significant difference was found between group 1 and group 3, and between group 2 and group 3 (p=0.696 and p=0.092, respectively). The presence of a short VL and a narrow ACD in eyes with RVO supports the theory of mechanical thrombus formation in the retinal vein that we mentioned above.

One of the main risk factors for RVO is older age. The prevalence of the disease increases with age. An increase in LT is also observed with the development of cataract in older age. Therefore, it is difficult to say that LT is one of the mechanical factors that may play a direct role in the development of RVO due to the introduction of age-related confounding factors. In our study, there was no statistically significant difference in LT between the groups.

Limitations

Our study also has many limitations. As it was a retrospective study, it was not possible to assess the presence of hematological diseases that may predispose to thrombosis and the medications used by the patients. Although the number of patients was determined according to the power analysis, the power of the study was affected by the fact that the study was not conducted with a larger number of patients.

CONCLUSION

Our results suggest that short AL is a risk factor for the development of RVO. However, it should be noted that ocular and systemic factors should be considered in the development of the disease. Further studies with more patients with RVO and control groups should be performed.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of the Hitit University Non-interventional Researches Ethics Committee (Date: 05.04.2024, Decision No: 2024-08).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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