Original Research Article
Journal of Kathmandu Medical College, Vol. 13, No. 3, Issue 49, Jul.-Sep., 2024

Ocular biometry and refractive characteristics in patients with retinal vein occlusion: A cross-sectional comparative study

Sharma CA,[1] **Karki P,**[1] **Thapa M,**[1] **Chhetri S**[1]

[1]Chewan Acharya Sharma, [1]Pratap Karki, [1]Madhu Thapa, [1]Suraj Chhetri; Department of Ophthalmology, Maharajgunj Medical Campus, Institute of Medicine, Tribhuvan University, Kathmandu, Nepal, B.P. Koirala Lions Centre for Ophthalmic Studies, Kathmandu, Nepal

ABSTRACT

Introduction: Retinal vein occlusion is characterized by retinal and subretinal haemorrhages, macular oedema, and a varying degree of retinal ischemia. There is an increased risk with cardiovascular diseases but not all people with retinal vein occlusion reflect aggressive form of systemic diseases. In that situation, the role of ocular biometry and refraction is still essential to be studied.

Objectives: To compare the ocular biometry and refractive error of affected eyes of patients with retinal vein occlusion to their fellow eyes and the control group.

Methodology: This is a cross-sectional comparative study carried out at B.P. Koirala Lions Centre for Ophthalmic Studies. Ethical clearance was obtained from the institutional review committee of institute of Medicine. The calculated sample size was 60. After obtaining informed consent, 67 patients with retinal vein occlusion and 67 controls were enrolled using purposive sampling technique. Refractive error was determined using an auto-refractometer (Topcon KR-800). Keratometry, Anterior chamber depth, and Axial length were measured using IOL-Master-500. Different statistical test like t-test, chi-square test and ANOVA were used to analyse the data.

Results: The eyes with retinal vein occlusion were not significantly different either from fellow eyes or the control group in biometric indices like average keratometry, anterior chamber depth, and axial length. Significant hyperopia was found among central retinal vein occlusion group as compared to the fellow eye.

Conclusion: Biometric indices and refractive error in retinal vein occlusion cases were not significantly different from the control group. Central retinal vein occlusion was found to be significantly predisposed in more Hyperopic eyes as compared to fellow eyes.

Keywords: Biometry; Hyperopia; Retinal Vein Occlusion.

Access this article online

Website: www.jkmc.com.np

DOI: https://doi.org/10.3126/jkmc.v13i3.82878

HOW TO CITE
Sharma CA, Karki P, Thapa M, Chhetri S. Ocular biometry and refractive characteristics in patients with retinal vein occlusion: A cross-sectional comparative study. J Kathmandu Med Coll. 2024;13(3):167-71.

Submitted: Jul 21, 2024
Accepted: Jul 10, 2025
Published: Aug 5, 2025

Address for correspondence
Mr. Chewan Acharya Sharma,
B. Optometry
Department of Ophthalmology,
B.P. Koirala Lions Centre for Ophthalmic Studies, Kathmandu
Maharajgunj Medical Campus, Institute of Medicine, Tribhuvan University, Kathmandu, Nepal
E-mail: hellochewan@gmail.com

INTRODUCTION

Retinal vein occlusion (RVO) is characterized by the dilatation of retinal veins with retinal and subretinal haemorrhages, macular oedema, and a varying degree of retinal ischemia. Arteriosclerotic thickening of a retinal arteriole is associated with the compression of a vein at an arteriovenous crossing, exacerbated by sharing an adventitial sheath.[1-4] RVO has two divisions based on the site of occlusion: Central (CRVO) and Branch (BRVO) retinal vein occlusion. In Nepal, overall population prevalence for RVO was 2.95%, BRVO 2.74%, CRVO 0.21%

ISSN: 2019-1785 (Print), 2091-1793 (Online)

and the mean age of prevalence was 61.1 + or - 12.3 years.[5-7]

An increased risk of RVOs was found with cardiovascular diseases, glaucoma, higher serum levels of α2-globulin etc.[2,8] But not all these people suffer from RVO and those who suffer necessarily may not have an aggressive form of systemic disease. So, a question exists if the ocular biometry and refraction itself can predispose retinal vein occlusion.

Fundus Fluorescein Angiography is the standard intervention to differentiate ischemic RVO. But it also takes over 6 months to develop ischemia and best corrected visual acuity worsens below 6/60.[3] As retinal morphology is changing after ischemia, these proxy indicators are used in this study to select only non-ischemic cases.

METHODOLOGY

This study was carried out at B.P. Koirala Lions Centre for Ophthalmic Studies (BPKLCOS), Institute of Medicine (IOM) from January 2023 to August 2023. Ethical approval was taken from Institutional Review Committee (IRC) of IOM [Ref. No.67(611)079/80]. Informed written consent was taken from all the participants. The sampling technique used in the study was purposive sampling. Cross-sectional comparative study design was used, where we collected cases and compared the findings with age and sex matched healthy volunteers, selecting only one eye per individual but alternating between the left and right eye for successive participants.

Cases of RVO with Best Corrected Visual Acuity ≥ 6/60 or within 6 months of onset were defined as non-ischemic RVOs and enrolled for the purpose of this study. For controls, patients having Visual Acuity ≥ 6/9, without RVO were enrolled. Cases or controls were excluded if the fundus was not visible in biomicroscopy or if there was any history of surgeries that could alter the refraction of the eye like the history of refractive surgery, cataract surgery, silicone oil insertion, gas tamponade or band buckle. Similarly, severe non-proliferative diabetic retinopathy, proliferative diabetic retinopathy, neovascular glaucoma, retinal detachment, preretinal hemorrhage, etc. were also excluded.

Sample size was calculated using the mean and standard deviations of axial length reported in previous RVO studies.[12-13] The average standard deviation (σ) was 1.16 mm, and the allowable margin of error (d) was 0.31 mm. At 95% confidence level (z = 1.96) with the formula n = $(z^2\ \sigma^2)/d^2$, and 10% non-response rate the calculated sample size was 60. We enrolled healthy volunteer as controls in the ratio of 1:1 for comparison. During our study period we got total 67 cases of RVO including both BRVO and CRVO and enrolled equal number of controls i.e. 67.

Distance best corrected visual acuity was recorded using Snellen's chart at 6 meters. The pupil was dilated with a single drop of Tropicamide one percent. Fundus was evaluated with slit lamp biomicroscopy using a +90 D lens. Retinal vein occlusion was diagnosed and classified as either CRVO or BRVO. The present status of Hypertension and diabetes mellitus was inquired. Refractive error was taken using an auto-refractometer (Topcon KR-800). Average keratometry reading, Anterior chamber depth, and Axial length were measured with IOL Master 500. The data was entered in the Statistical Package for Social Science (SPSS) version 26 for analysis. We used chi-square test to examine the association between systemic conditions and retinal vein occlusion. For parametric variables (visual acuity, spherical equivalent, keratometry, anterior chamber depth, axial length), independent t-tests were applied to compare cases versus controls among different groups, while paired t-tests were used for inter-eye comparisons within groups. *p* value less than 0.05 was considered statistically significant.

RESULTS

There were 61 retinal vein occlusion patients (32 male and 19 female) enrolled in the study out of which 37 patients (22 male and 15 female) had BRVO and 30 patients (18 male and 12 female) had CRVO. The mean age of patients with BRVO was 60 ± 11 years and the mean age of patients with CRVO was 57 ± 15 years. The control group was composed of 40 males and 27 females without retinal vein occlusion. The mean age of control was 60 ± 12 years (Table 1).

In our study, 27 (73.0%) of BRVO patients, 24 (78.6%) of CRVO patients and 34 (50.8%) of controls had a history of systemic hypertension ($p<0.05$). Similarly, 10 (27%) of BRVO patients, 13 (42.9%) of CRVO patients, and 20 (29.5%) of controls had a history of Diabetes Mellitus ($p>0.05$, Table 1).

We found that, In the BRVO group, the best corrected visual acuity in affected eyes was significantly poor compared to fellow or control eyes ($p<0.001$) but the Spherical equivalent of refractive error, mean average keratometry, anterior chamber depth, and axial length of

affected eyes were not significantly different either from fellow eyes or the control group (p>0.05, Table 2).

In the CRVO group, the best corrected visual acuity was significantly poor in affected eyes than in fellow or control eyes (p<0.001). The average keratometry, anterior chamber depth, and axial length of affected eyes were not significantly different either from fellow eyes or control eyes (p>0.05). The spherical equivalent of refraction of affected eyes was not significantly different from the control group (p=0.61) but was significantly more hyperopic compared to the fellow eye (p<0.05, Table 3).

The best corrected visual acuity of the affected eyes of the CRVO group was significantly poor compared to the affected eyes of the BRVO group (p<0.05). The spherical equivalent of refractive error, mean average keratometry, anterior chamber depth and axial lengths of affected eyes of the BRVO group and CRVO group were not significantly different (p>0.05, Table 4).

Table 1: Demographic Characteristics of patients with RVO and controls

Variables	BRVO	CRVO	Control	p-value
Number	37	30	67	
Gender (male: female)	22:15	18:12	40:27	0.265*
Age (mean ± SD, years)	60 ± 11	57 ± 15	60 ± 12	0.102†
Presence of systemic hypertension	73.0%	78.6%	50.8%	<0.05‡
Presence of Diabetes	27.0%	42.9%	29.5%	0.53‡

p - value significant at <0.05, *=Pearson Chi-Square Test, †=1-Way ANOVA test, ‡=Chi-square test

Table 2: Ocular measurements of patients with BRVO and controls

Variables	Eyes with BRVO			p-value		
	Control mean±SD	Affected mean±SD	Fellow mean±SD	Affected/ Control*§	Fellow/ Control§	Affected/ Fellow**
BCVA	0.07± 0.08	0.41± 0.30	0.09± 0.12	<0.001	0.226	<0.001
SER	0.52± 0.94	0.44± 1.12	0.42± 1.06	0.713	0.612	0.809
K_{avg}	43.97± 1.44	44.52± 1.64	44.54± 1.70	0.085	0.077	0.897
ACD	3.17± 0.33	3.21± 0.32	3.21± 0.30	0.509	0.483	0.948
AL	23.16± 0.91	22.99± 0.88	23.05± 0.86	0.371	0.551	0.148

p - value significant at <0.05, §=Independent t test, **=Paired sample t test.
BCVA – Best Corrected Visual Acuity in logMAR, SER – Spherical Equivalent of Refraction in Dioptre, K avg – Average Keratometry in Dioptre, ACD – Anterior Chamber Depth in mm, AL – Axial Length in mm

Table 3: Ocular measurements of patients with CRVO and controls

Variables	Eyes with CRVO			p-value		
	Control mean±SD	Affected mean±SD	Fellow mean±SD	Affected/ Control§	Fellow/ Control§	Affected/ Fellow**
BCVA	0.07± 0.08	0.72± 0.38	0.19± 0.14	<0.001	<0.001	<0.001
SER	0.52± 0.94	0.38± 0.78	0.01± 0.88	0.616	0.068	<0.05
K_{avg}	43.97± 1.44	44.62± 1.62	44.70± 1.63	0.138	0.099	0.364
ACD	3.17± 0.33	3.04± 0.44	3.18± 0.54	0.216	0.911	0.062
AL	23.16± 0.91	22.91± 1.02	22.88± 1.00	0.359	0.315	0.719

p - value significant at <0.05, §=Independent t test, **=Paired sample t test
BCVA – Best Corrected Visual Acuity in logMAR, SER – Spherical Equivalent of Refraction in Dioptre, K_{avg} – Average Keratometry in Dioptre, ACD – Anterior Chamber Depth in mm, AL – Axial Length in mm

Table 4: Ocular measurements of patients with BRVO and CRVO

Variables	BRVO (mean±SD)	CRVO (mean±SD)	p-value[§]
BCVA	0.41± 0.30	0.72± 0.38	<0.05
SE	0.44± 1.12	0.38± 0.78	0.834
K_{avg}	44.52± 1.64	44.62± 1.62	0.839
ACD	3.21± 0.32	3.04± 0.44	0.194
AL	22.99± 0.88	22.91± 1.02	0.781

p - value significant at <0.05, [§]=Independent sample t test
BCVA – Best Corrected Visual Acuity in logMAR, SER – Spherical Equivalent of Refraction in Dioptre, K_{avg} – Average Keratometry in Dioptre, ACD – Anterior Chamber Depth in mm, AL – Axial Length in mm

DISCUSSION

As the axial length of an eye is measured as the distance from the cornea to the internal limiting membrane in the A-scan USG and as the distance from the cornea to the retinal pigment epithelium in the IOL Master; measurement of axial length with IOL Master is considerably unaffected by any amount of retinal oedema due to Retinal Vein Occlusions.[9] However, the biometric findings of this study have shown no significant difference in average keratometry, anterior chamber depth, axial length, of neither the BRVO nor CRVO group from the control group. Although, CRVO was found to be significantly predisposed in more Hyperopic eyes compared to fellow eyes.

There are several disputing findings in different literatures about the association of ocular biometry and RVO. In a study done by Mousavi et. al., Axial length in eyes with CRVO was significantly shorter in comparison to the control group (p=0.003).[10] Bandello et. al. couldn't implicate axial length and refraction on the occurrence of CRVO. However, their study resulted that the smaller the myopic refraction or the greater the hypermetropic refraction, the greater the risk to develop BRVO (odds ratio 1.37, p=0.0004).[11] Szigeti et. al. found that the mean axial length and Vitreous Chamber Depth of the affected eyes were significantly shorter (p<0.05) compared to the control eyes.[12] Ariturk et. al. found that the mean axial length of affected eyes of patients with CRVO were significantly shorter than fellow eyes and also than that of eyes of patients with BRVO (p<0.05).[13] Mirshahi et. al. found that the mean axial length of affected eyes were not statistically significantly shorter than that of fellow eyes in the CRVO group.[14] Neither there were significant differences in axial length between the control and affected eyes.

The thickness of lamina cribrosa and peripapillary sclera is found to increase significantly with decreasing axial length which can thus reduce the blood flow turbulence and cause endothelial damage and thrombus formation.[15-16] The histopathological studies also reveal thrombus formation at or near the lamina cribrosa in eyes with CRVO and at the arteriovenous junction in BRVO.[8] The above mentioned studies argue accordingly but the systemic factors like hypertension, thrombophilia, diabetes, hyperlipidemia, hyperuricemia, etc. as well as behavioural factors like smoking, lack of physical exercise, diet etc. which contribute to the multifactorial causation of non-communicable diseases like Retinal Vein Occlusion are a group of untouched confounding factors.[2,4,17] Therefore, it seems that the role of axial length and refraction in causation of these diseases requires further evidence to be conclusive.

Several systemic risk factors such as hypertension, diabetes, hyperlipidemia, cardiovascular diseases, blood viscosity, etc. and behavioral factors such as diet, smoking status, physical activity, etc. are likely to confound RVO. It was challenging to match exact systemic illness, behavioural factors, age, sex, etc. This limitation may have introduced residual confounding. Therefore, in a multi-factorial disease like RVO, biometric findings would be revealed only if multiple confounders are controlled.

CONCLUSION

The study assessed biometry and refractive error in various BRVO and CRVO cases and age and gender-matched volunteers. Although, biometric indices and refractive error of Retinal vein occlusion cases were insignificantly different from the control group; CRVO was found significantly predisposed in more Hyperopic eyes compared to fellow eyes.

AKNOWLEDGEMENT: We owe to all whom we had pleasure to work with during this study.

Conflicts of Interest: None
Source of Support: None

REFERENCES:

1. Jonas JB, Monés J, Glacet-Bernard A, Coscas G. Retinal Vein Occlusions. Dev Ophthalmol. 2017;58:139–67. [Pub Med| Full Text | DOI]
2. Bowling B, Kanski JJ. Kanski's clinical ophthalmology: a systematic approach. 8. ed. s.l. Elsevier; 2016. 917 p. (Expert consult) [Full Text]
3. Khayat M, Williams M, Lois N. Ischemic retinal vein occlusion: characterizing the more severe spectrum of retinal vein occlusion. Surv Ophthalmol. 2018 Nov;63(6):816–50. [Pub Med | Full Text| DOI]
4. Terao R, Fujino R, Ahmed T. Risk Factors and Treatment Strategy for Retinal Vascular Occlusive Diseases. J Clin Med. 2022 Oct 27;11(21):6340. [Pub Med | FullText | DOI]
5. Laouri M, Chen E, Looman M, Gallagher M. The burden of disease of retinal vein occlusion: review of the literature. Eye. 2011 Aug;25(8):981–8. [Pub Med | Full Text| DOI]
6. Thapa R, Bajimaya S, Paudyal G, Khanal S, Tan S, Thapa SS, et al. Prevalence, pattern and risk factors of retinal vein occlusion in an elderly population in Nepal: the Bhaktapur retina study. BMC Ophthalmol. 2017 Dec;17(1):162. [Pub Med | Full Text| DOI]
7. Thapa R, Paudyal G, Bernstein PS. Demographic characteristics, patterns and risk factors for retinal vein occlusion in Nepal: a hospital-based case-control study: Retinal vein occlusion in Nepal. Clin Experiment Ophthalmol. 2010 Aug;38(6):583–90. [Pub Med | Full Text| DOI]
8. Rehak M, Wiedemann P. Retinal vein thrombosis: pathogenesis and management. J Thromb Haemost. 2010 Sep;8(9):1886–94. [Pub Med| Full Text| DOI]
9. iu R, Li H, Li Q. Differences in Axial Length and IOL Power Based on Alternative A-Scan or Fellow-Eye Biometry in Macula-Off Rhegmatogenous Retinal Detachment Eyes. Ophthalmol Ther. 2022 Feb;11(1):347–54. [Pub Med| Full Text | DOI]
10. Mousavi M, Naseri MH, Shoeibi N. Axial Length in Retinal Vein Occlusion. 2015;3(1):3. [Full Text| DOI]
11. Bandello F, Tavola A, Pierro L, Modorati G, Azzolini C, Brancato R. Axial Length and Refraction in Retinal Vein Occlusions. Ophthalmologica. 1998;212(2):133–5. [Pub Med| Full Text| DOI]
12. Szigeti A, Schneider M, Ecsedy M, Nagy ZZ, Récsán Z. Association between retinal vein occlusion, axial length and vitreous chamber depth measured by optical low coherence reflectometry. BMC Ophthalmol. 2015 Dec;15(1):45. [Pub Med| Full Text| DOI]
13. Ariturk N, Oge Y, Erkan D, Sullu Y, Mohajery F. Relation between retinal vein occlusions and axial length. Br J Ophthalmol. 1996 Jul 1;80(7):633–6. [Pub Med| Full Text| DOI]
14. Mirshahi A, Moghimi S. Central retinal vein occlusion: Role of axial length. Asian J Ophthalmol. 2005;7:149-51. [Full Text]
15. Ren R, Wang N, Li B, Li L, Gao F, Xu X, et al. Lamina Cribrosa and Peripapillary Sclera Histomorphometry in Normal and Advanced Glaucomatous Chinese Eyes with Various Axial Length. Investig Opthalmology Vis Sci. 2009 May 1;50(5):2175. [Pub Med| Full Text | DOI]
16. Gupta RC, Mengi R. To Study The Relationship Between The Axial Length of The Eye Ball and the Retinal Vein Occlusion. 2010;12(4):4. [Full Text]
17. Hayreh SS, Podhajsky PA, Zimmerman MB. Natural history of visual outcome in central retinal vein occlusion. Ophthalmology. 2011 Jan 1;118(1):119-33. Available from: [Pub Med| Full Text | DOI]