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Original Research Paper

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CLINICAL PROFILE AND SYSTEMIC RISK FACTORS IN PATIENTS WITH RETINAL VEIN OCCLUSION: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Retinal vein occlusion (RVO) is an important retinal vascular disorder associated with systemic vascular risk factors and macular edema. Early recognition of associated systemic abnormalities and appropriate retinal treatment is essential for preserving vision. This study evaluated the clinical profile, systemic risk factors, and treatment outcomes of patients with RVO, with particular emphasis on anti-VEGF therapy and laser photocoagulation. **Methods:** This prospective comparative randomized clinical study included 44 patients with retinal vein occlusion (RVO), who were followed for 12 months. Patients underwent comprehensive clinical assessment, including demographic characteristics, systemic risk factors, best-corrected visual acuity, intraocular pressure, and retinal findings. Optical coherence tomography (OCT) was performed to assess central macular thickness (CMT) and macular edema. Patients were randomly allocated to receive either intravitreal anti-VEGF therapy or laser photocoagulation, and functional and anatomical outcomes were assessed and compared during the follow-up period. **Results:** The mean age was 58.4 ± 8.3 years in the anti-VEGF group and 59.8 ± 7.9 years in the laser group. Hypertension was the most common systemic risk factor (72.7% vs. 68.2%), followed by dyslipidemia/hypercoagulable states (54.5% vs. 59.1%) and diabetes mellitus (45.5% vs. 50.0%). At 12 months, BCVA improved to 0.16 ± 0.11 logMAR with anti-VEGF compared with 0.27 ± 0.15 logMAR with laser ($p=0.002$). CMT decreased to 215.7 ± 36.2 μm and 268.4 ± 45.8 μm, respectively ($p=0.001$). Macular edema resolved in 100% and 81.8% of eyes, respectively ($p=0.048$). **Conclusion:** RVO was strongly associated with systemic vascular risk factors. Anti-VEGF therapy provided superior visual and anatomical outcomes compared with laser photocoagulation.

KEYWORDS : Retinal vein occlusion; Anti-VEGF; Laser photocoagulation; Macular edema; Optical coherence tomography.

1. INTRODUCTION

Retinal vein occlusion (RVO) is one of the most common retinal vascular disorders and an important cause of visual impairment, particularly among middle-aged and elderly individuals. It results from obstruction of the retinal venous circulation, leading to retinal haemorrhage, venous dilatation, retinal oedema, and varying degrees of macular involvement [1]. RVO is broadly classified into branch retinal vein occlusion (BRVO) and central retinal vein occlusion (CRVO), depending on the site of venous obstruction [2]. Macular oedema is the major cause of reduced visual acuity in patients with RVO and may produce persistent functional impairment when inadequately treated [3].

The development of RVO is multifactorial and is strongly associated with systemic vascular and metabolic abnormalities [4]. Hypertension is consistently identified as one of the most important systemic risk factors, reflecting the role of chronic vascular damage in retinal venous obstruction [5,6]. Diabetes mellitus, dyslipidaemia, cardiovascular disease, and systemic atherosclerosis have also been associated with an increased risk of RVO [7,8]. Increasing age further contributes to disease occurrence through cumulative vascular changes and endothelial dysfunction [9]. Other reported associations include smoking, obesity, renal disease, and hypercoagulable states, although their contribution may vary among different populations [10,11].

Assessment of the clinical profile and systemic risk factors is therefore essential for understanding the disease burden and identifying potentially modifiable factors. A detailed ophthalmic examination helps determine the type and severity of RVO, while evaluation of systemic health may reveal previously undiagnosed hypertension, diabetes, or lipid abnormalities [12,13]. Recognition and appropriate management of these systemic conditions may reduce the risk of vascular compli-cations and potentially improve long-term ocular outcomes [14,15]. Therefore, the present prospective observational study was undertaken to evaluate the clinical profile and systemic risk factors among patients with RVO, with particular emphasis on demographic characteristics, clinical presentation, and associated systemic conditions.

2. METHODOLOGY

The present prospective observational study was conducted in the Upgraded Department of Ophthalmology, N.S.C.B. Medical College & Hospital, Jabalpur, Madhya Pradesh, India, from July 2024 to December 2025. Patients aged ≥18 years with confirmed branch or central retinal vein occlusion (BRVO/CRVO), associated macular edema, central macular thickness ≥250 μm on spectral-domain OCT, BCVA of 20/30–20/200 (logMAR 0.2–1.0), adequate media clarity, and willingness to provide informed consent and comply with follow-up were included. Patients with other retinal vascular diseases, recent vitreoretinal surgery, epiretinal membrane or vitreomacular traction, recent intravitreal injections or laser treatment, media opacity preventing OCT assessment, glaucoma or IOP >21 mmHg, pregnancy or lactation, active ocular inflammation or infection, inability to provide consent, uncontrolled hypertension (>180/110 mmHg), or recent myocardial infarction or stroke were excluded.

Eligible patients were recruited consecutively from the ophthalmology outpatient, inpatient, and emergency departments. A total of 44 patients were enrolled, with 22 patients receiving intravitreal anti-VEGF therapy (Group A) and 22 receiving laser photocoagulation (Group B). Allocation was performed using computer-generated random numbers with sealed-envelope concealment. Demographic characteristics, systemic risk factors, ocular history, presenting symptoms, laterality, RVO type, BCVA, IOP, retinal findings, macular edema, and OCT parameters including central macular thickness were recorded. Detailed ophthalmic examination included refraction, slit-lamp examination, Goldmann applanation tonometry, fundus examination, and OCT assessment. Data were prospectively recorded using a structured proforma and follow-up findings were documented. Continuous variables were expressed as mean ± SD and categorical variables as frequencies and percentages. Appropriate parametric or non-parametric tests, Chi-square test, or Fisher's exact test were used, with $p<0.05$ considered statistically significant. Institutional Ethics Committee approval was obtained, written informed consent was taken, and participant confidentiality was maintained throughout the study.

3. RESULTS

Table 1. Baseline Demographic and Clinical Characteristics of the Study Participants

Characteristic	Anti-VEGF Group (n=22)	Laser Group (n=22)	p-value
Age (years)			
Mean ± SD	58.4 ± 8.3	59.8 ± 7.9	0.463
Range	42–72	45–74	—
Gender			
Male, n (%)	14 (63.6%)	13 (59.1%)	0.742
Female, n (%)	8 (36.4%)	9 (40.9%)	—
Eye involved			
Right eye, n (%)	12 (54.5%)	11 (50.0%)	0.743
Left eye, n (%)	10 (45.5%)	11 (50.0%)	—
Type of RVO			
BRVO, n (%)	16 (72.7%)	17 (77.3%)	0.642
CRVO, n (%)	6 (27.3%)	5 (22.7%)	—

The mean age was 58.4 ± 8.3 years in the anti-VEGF group and 59.8 ± 7.9 years in the laser group, with male predominance (63.6% vs. 59.1%). Right-eye involvement was 54.5% and 50.0%, respectively. BRVO was predominant (72.7% vs. 77.3%), while CRVO occurred in 27.3% and 22.7%.

Table 2. Systemic Risk Factors among Patients with Retinal Vein Occlusion

Systemic Risk Factor	Anti-VEGF Group (n=22)	Laser Group (n=22)	p-value
Hypertension, n (%)	16 (72.7%)	15 (68.2%)	0.707
Diabetes mellitus, n (%)	10 (45.5%)	11 (50.0%)	0.743
Type 2 diabetes among diabetics	9 (90.0%)	10 (90.9%)	1.000
Dyslipidemia/hypercoagulable states, n (%)	12 (54.5%)	13 (59.1%)	0.718
Current smoker, n (%)	6 (27.3%)	5 (22.7%)	0.819
Former smoker, n (%)	8 (36.4%)	9 (40.9%)	—
Never smoker, n (%)	8 (36.4%)	8 (36.4%)	—
Coronary artery disease, n (%)	5 (22.7%)	4 (18.2%)	0.695
Previous stroke, n (%)	3 (13.6%)	2 (9.1%)	0.647
Hyperhomocysteinemia, n (%)	4 (18.2%)	3 (13.6%)	0.682

Hypertension was the most common risk factor (72.7% vs. 68.2%), followed by dyslipidemia/hypercoagulable states (54.5% vs. 59.1%) and diabetes mellitus (45.5% vs. 50.0%). Smoking occurred in 27.3% and 22.7%, respectively, while coronary artery disease, stroke, and hyperhomocysteinemia were less frequent.

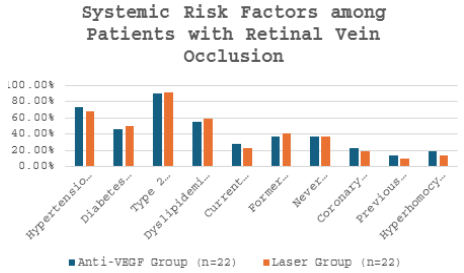

Figure 1. Systemic Risk Factors Among Patients with Retinal Vein Occlusion

Table 3. Baseline Ophthalmological Characteristics

Parameter	Anti-VEGF Group (n=22)	Laser Group (n=22)	p-value
BCVA (logMAR), mean ± SD	0.42 ± 0.18	0.45 ± 0.20	0.598
IOP (mmHg), mean ± SD	16.3 ± 2.8	16.7 ± 2.5	0.555
CMT (μm), mean ± SD	421.5 ± 68.3	428.7 ± 71.2	0.693
CMT range	284–567	295–589	—
Macular volume (mm^3), mean ± SD	11.8 ± 2.1	12.2 ± 2.3	0.546

Baseline ocular characteristics were comparable between groups. Mean BCVA was 0.42 ± 0.18 vs. 0.45 ± 0.20 logMAR, IOP was 16.3 ± 2.8 vs. 16.7 ± 2.5 mmHg, and CMT was 421.5 ± 68.3 vs. 428.7 ± 71.2 μm in anti-VEGF and laser groups, respectively. Macular volume was 11.8 ± 2.1 vs. 12.2 ± 2.3 mm^3, with no significant differences.

Table 4. Longitudinal Changes in BCVA and Visual Acuity Response

Time Point / Response	Anti-VEGF	Laser	p-value
BCVA (logMAR), mean ± SD			
Baseline	0.42 ± 0.18	0.45 ± 0.20	0.598
Week 1	0.40 ± 0.18	0.44 ± 0.21	0.421
Week 4	0.36 ± 0.16	0.40 ± 0.19	0.351
Week 8	0.32 ± 0.15	0.37 ± 0.17	0.234
Month 3	0.28 ± 0.14	0.35 ± 0.18	0.089
Month 6	0.22 ± 0.13	0.32 ± 0.17	0.028
Month 9	0.18 ± 0.12	0.29 ± 0.16	0.004
Month 12	0.16 ± 0.11	0.27 ± 0.15	0.002
Change from baseline	-0.26 ± 0.12	-0.18 ± 0.13	0.022
Visual response at 12 months			
≥10 ETDRS-letter improvement	20 (90.9%)	16 (72.7%)	0.112
≥5 ETDRS-letter improvement	21 (95.5%)	18 (81.8%)	0.148
Stable	1 (4.5%)	4 (18.2%)	0.153
Deterioration >4 letters	0 (0%)	0 (0%)	—

BCVA improved in both groups, with greater improvement after anti-VEGF therapy. At Month 12, BCVA was 0.16 ± 0.11 vs. 0.27 ± 0.15 logMAR, with a change of -0.26 ± 0.12 vs. -0.18 ± 0.13 (p=0.022). The difference became significant from Month 6. At 12 months, ≥10-letter gain occurred in 90.9% vs. 72.7%, while ≥5-letter improvement occurred in 95.5% vs. 81.8%.

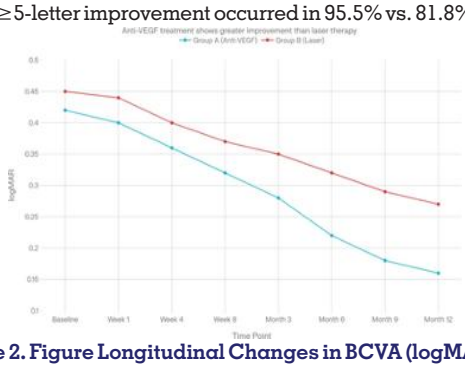

Figure 2. Figure Longitudinal Changes in BCVA (logMAR)

Table 5. Changes in Central Macular Thickness and Macular Edema Resolution

Time Point	CMT Anti-VEGF (μm)	CMT Laser (μm)	p-value
Baseline	421.5 ± 68.3	428.7 ± 71.2	0.693
Week 1	365.2 ± 60.4	420.3 ± 69.8	0.041
Week 4	310.4 ± 55.2	385.6 ± 64.2	0.018
Week 8	285.4 ± 52.3	355.2 ± 61.8	0.009
Month 3	255.3 ± 48.1	315.7 ± 57.4	0.005
Month 6	230.1 ± 42.5	285.3 ± 51.2	0.003
Month 9	220.4 ± 38.9	275.1 ± 48.6	0.002
Month 12	215.7 ± 36.2	268.4 ± 45.8	0.001
Change from baseline	-205.8 ± 46.1	-160.3 ± 48.2	0.007
% reduction	48.8% ± 8.5%	37.4% ± 9.1%	0.001
Macular edema resolution			
Week 4	2 (9.1%)	1 (4.5%)	0.591
Week 8	8 (36.4%)	3 (13.6%)	0.075
Month 3	14 (63.6%)	8 (36.4%)	0.081
Month 6	18 (81.8%)	12 (54.5%)	0.058
Month 9	21 (95.5%)	15 (68.2%)	0.013
Month 12	22 (100%)	18 (81.8%)	0.048

CMT decreased earlier and more markedly with anti-VEGF therapy. At Month 12, CMT was 215.7 ± 36.2 vs. 268.4 ± 45.8 μm (p=0.001), with 48.8% vs. 37.4% reduction. Macular edema resolution was also higher with anti-VEGF, reaching 100% vs. 81.8% at Month 12 (p=0.048).

Table 6. Treatment Response According to RVO Type and Systemic Risk Factors

Subgroup / Outcome	Anti-VEGF	Laser	p-value
BRVO (n=33)			
BCVA change (logMAR)	-0.27 ± 0.11	-0.19 ± 0.12	0.031
CMT reduction (μm)	-207.3 ± 43.2	-158.4 ± 46.1	0.009
Time to edema resolution (days)	76.1 ± 29.3	123.4 ± 41.2	0.002
CRVO (n=11)			
BCVA change (logMAR)	-0.22 ± 0.15	-0.15 ± 0.16	0.358
CMT reduction (μm)	-191.2 ± 52.4	-161.8 ± 54.3	0.296
Time to edema resolution (days)	82.7 ± 35.8	129.8 ± 45.1	0.138
Systemic Risk-Factor Subgroups			
Hypertensive – BCVA change	-0.25 ± 0.12	-0.17 ± 0.13	0.042
Non-hypertensive – BCVA change	-0.28 ± 0.12	-0.22 ± 0.12	0.251
Diabetic – BCVA change	-0.26 ± 0.11	-0.19 ± 0.14	0.058
Non-diabetic – BCVA change	-0.27 ± 0.13	-0.17 ± 0.11	0.033

Anti-VEGF showed significantly better outcomes in BRVO, with greater BCVA improvement, greater CMT reduction, and faster edema resolution. CRVO outcomes favored anti-VEGF but did not reach statistical significance.

Table 7. Ocular Adverse Events During 12-Month Follow-up

Adverse Event	Anti-VEGF (n=22)	Laser (n=22)	p-value
Any IOP elevation >5 mmHg	3 (13.6%)	1 (4.5%)	0.316
Sustained IOP >21 mmHg	0 (0%)	0 (0%)	—
Mild anterior chamber reaction	2 (9.1%)	1 (4.5%)	0.591
Moderate anterior chamber reaction	0 (0%)	0 (0%)	—
Endophthalmitis	0 (0%)	0 (0%)	—
Retinal detachment	0 (0%)	0 (0%)	—
Vitreous hemorrhage	0 (0%)	0 (0%)	—
Cataract progression	2 (9.1%)	1 (4.5%)	0.591
Subretinal fibrosis	0 (0%)	1 (4.5%)	0.315

Both treatments showed a favorable 12-month safety profile. IOP elevation >5 mmHg occurred in 13.6% vs. 4.5% (p=0.316), with no sustained IOP >21 mmHg. Mild inflammation occurred in 9.1% vs. 4.5%. No endophthalmitis, retinal detachment, or vitreous hemorrhage occurred. Cataract progression was 9.1% vs. 4.5%, while one case of subretinal fibrosis occurred in the laser group.

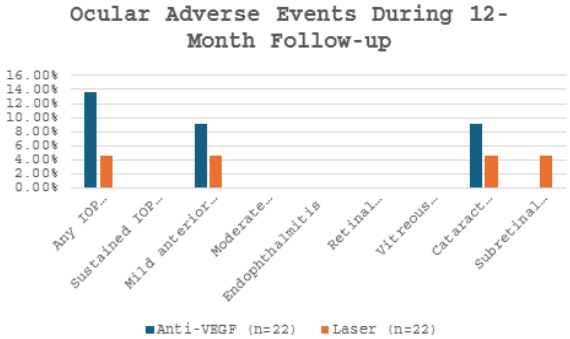

Figure 3. Ocular Adverse Events During 12-month Follow-up

4. DISCUSSION

The present prospective comparative study evaluated the clinical profile, systemic risk factors, and treatment outcomes of 44 patients with retinal vein occlusion (RVO), with 22 patients in each treatment group completing 12 months of follow-up. Baseline characteristics were comparable, with mean age of 58.4 ± 8.3 years in the anti-VEGF group and 59.8 ± 7.9 years in the laser group (p=0.463). Males constituted 63.6% and 59.1%, respectively, while BRVO predominated (72.7% vs. 77.3%). These findings were consistent with Aggarwal et al. (2025), [16] who reported that the sixth and seventh decades accounted for 31.35% and 31.57% of BRVO cases, with male predominance of 57.80% and unilateral involvement in 93.31%.

Hypertension was the most frequent systemic risk factor (72.7% vs. 68.2%), followed by dyslipidemia/hypercoagulable states (54.5% vs. 59.1%), diabetes mellitus (45.5% vs. 50.0%), and smoking (27.3% vs. 22.7%). Trovato et al. (2022), [17] similarly demonstrated significant associations of CRVO with uncontrolled hypertension (OR 3.656; p<0.001), type II diabetes (OR 4.533; p<0.001), hyperhomocysteinemia (OR 4.507; p<0.001), dyslipidemia (OR 2.255; p=0.002), active smoking (OR 2.048; p=0.008), coronary artery disease (OR 6.632; p<0.001), glaucoma (OR 4.656; p<0.001), obstructive sleep apnea (OR 1.744; p=0.041), and age (OR 1.109; p<0.001). Sartori et al. (2013), [18] also reported cardiovascular risk factors in 58% of patients younger than 50 years and 91% of those older than 50 years (p<0.001), supporting the systemic vascular association of RVO.

Treatment outcomes favored anti-VEGF therapy. Baseline BCVA was 0.42 ± 0.18 versus 0.45 ± 0.20 logMAR and CMT was 421.5 ± 68.3 versus 428.7 ± 71.2 μm. At 12 months, BCVA improved to 0.16 ± 0.11 versus 0.27 ± 0.15 logMAR (p=0.022), while CMT decreased to 215.7 ± 36.2 versus 268.4 ± 45.8 μm (p=0.001). Macular edema resolved in 100% versus 81.8% (p=0.048). In BRVO, BCVA change was -0.27 ± 0.11 versus -0.19 ± 0.12 logMAR (p=0.031), supporting the findings of Aggarwal et al. [16] Beaumont et al. (2002), [19] and Chauhan et al. (2026). [20] Overall, anti-VEGF demonstrated superior anatomical and functional outcomes, while systemic risk-factor assessment and long-term surveillance remain essential.

CONCLUSION

RVO was common in older individuals and frequently associated with hypertension, diabetes, dyslipidemia, and smoking. Both treatments improved outcomes, but anti-VEGF provided greater visual and anatomical improvement with faster macular edema resolution, particularly in BRVO, while maintaining a favorable safety profile.

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