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Original Research Article

# Retinal Vein Occlusion (RVO): Outcomes of Anti-VEGF vs Steroid Treatment for Macular Edema

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**Abstract**

**Background:** Retinal vein occlusion (RVO) is the second most common retinal vascular disorder after diabetic retinopathy and a major cause of visual impairment worldwide. Macular edema is the principal cause of vision loss in RVO. Intravitreal anti-vascular endothelial growth factor (anti-VEGF) agents and intravitreal corticosteroids are the most widely used treatment modalities for RVO-related macular edema. However, comparative clinical outcomes between these therapies remain a subject of ongoing clinical interest.

**Aim:** To compare the visual and anatomical outcomes of anti-VEGF therapy and intravitreal steroid treatment in patients with macular edema secondary to retinal vein occlusion.

**Methods:** A hospital-based prospective observational study was conducted at Government Medical College & Hospital, West Champaran, Bettiah, Bihar, India from 5th March 2025 to 25th February 2026. A total of 150 patients with RVO-associated macular edema were enrolled. Patients were divided into two treatment groups: anti-VEGF group (n=80) and steroid group (n=70). Outcomes assessed included best corrected visual acuity (BCVA), central macular thickness (CMT) measured by optical coherence tomography (OCT), and treatment-related adverse events over a 6-month follow-up period.

**Results:** Both treatment groups showed significant improvement in BCVA and reduction in CMT. The anti-VEGF group demonstrated a greater improvement in visual acuity (mean BCVA improvement 0.32 ± 0.09 logMAR) compared with the steroid group (0.25 ± 0.08 logMAR, $p<0.05$). Mean CMT reduction was 185 ± 42 µm in the anti-VEGF group versus 160 ± 39 µm in the steroid group. Elevated intraocular pressure was significantly more common in the steroid group (18.6%) compared with the anti-VEGF group (4.8%).

**Conclusion:** Both anti-VEGF and steroid therapies effectively improve visual and anatomical outcomes in RVO-related macular edema. However, anti-VEGF therapy demonstrated superior visual improvement and a lower incidence of adverse events, supporting its role as the preferred first-line treatment.

**Keywords:** Retinal vein occlusion, Macular edema, Anti-VEGF, Intravitreal steroids, Visual acuity, OCT.

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## Introduction

Retinal vein occlusion (RVO) represents one of the most common retinal vascular diseases and is considered the second leading cause of vision loss due to retinal vascular disorders after diabetic retinopathy [1]. The disease occurs due to obstruction of retinal venous circulation leading to retinal hemorrhage, ischemia, and increased vascular permeability, which ultimately results in macular edema and visual impairment [2]. RVO is broadly classified into central retinal vein occlusion (CRVO) and branch retinal vein occlusion (BRVO) depending on the location of venous obstruction [3]. The global prevalence of RVO is estimated to affect approximately 16 million people worldwide, highlighting its significant public health burden [4]. Several systemic and ocular risk factors have been implicated in the development of RVO, including hypertension, diabetes mellitus, hyperlipidemia, glaucoma, and increasing age [5]. Among these factors, systemic vascular diseases play a particularly important role in the pathogenesis of RVO by promoting vascular endothelial dysfunction and thrombotic events [6]. Macular edema is the primary cause of vision loss in RVO and occurs due to breakdown of the blood-retinal barrier leading to fluid accumulation in the macula [7]. Elevated levels

of inflammatory cytokines and vascular endothelial growth factor (VEGF) are observed in the vitreous humor of patients with RVO, contributing to increased vascular permeability and macular thickening [8]. The development of macular edema is therefore a critical therapeutic target in the management of RVO.

Historically, treatment options for RVO-associated macular edema included laser photocoagulation, particularly grid laser therapy for BRVO, which aimed to reduce macular edema and improve visual outcomes [9]. However, the visual improvement achieved with laser therapy was often limited and delayed, leading to the exploration of pharmacologic therapies that directly target the underlying pathophysiology [10].

The introduction of anti-vascular endothelial growth factor (anti-VEGF) therapy revolutionized the management of RVO. Anti-VEGF agents such as ranibizumab, bevacizumab, and aflibercept inhibit VEGF activity, thereby reducing vascular permeability and macular edema [11]. Several randomized clinical trials have demonstrated significant visual acuity improvements following anti-VEGF therapy in patients with RVO-related macular edema [12].

Another important therapeutic approach involves the use of intravitreal corticosteroids, including triamcinolone acetonide and dexamethasone implants. Corticosteroids exert their effects by reducing inflammation, stabilizing the blood-retinal barrier, and inhibiting VEGF expression [13]. Steroid therapy has shown promising anatomical outcomes in patients with RVO-related macular edema, particularly in cases resistant to anti-VEGF therapy [14].

Despite the availability of these treatments, there remains ongoing debate regarding the relative efficacy and safety of anti-VEGF agents compared with corticosteroids in routine clinical practice [15]. Anti-VEGF therapy typically requires repeated injections, which may increase treatment burden and cost for patients [16]. Conversely, steroid therapy is associated with potential complications such as elevated intraocular pressure and cataract formation [17]. Recent studies have attempted to compare the effectiveness of anti-VEGF therapy and steroid treatment for macular edema secondary to RVO. While anti-VEGF agents often demonstrate superior visual outcomes, steroid therapy may offer advantages in terms of longer duration of action and fewer injections [18]. Therefore, understanding the comparative outcomes of these therapies is essential for optimizing treatment strategies. In India and other developing countries, limited data are available regarding real-world treatment outcomes of RVO using anti-VEGF and steroid therapies. Regional variations in patient characteristics, healthcare accessibility, and treatment adherence may influence clinical outcomes [19]. Therefore, evaluating treatment outcomes in local populations is important for guiding clinical practice.

The present study was conducted at Government Medical College & Hospital, Bettiah, Bihar, with the objective of comparing the visual and anatomical outcomes of anti-VEGF therapy versus intravitreal steroid treatment in patients with macular edema secondary to retinal vein occlusion.

## Materials and Methods

This prospective observational study was conducted in the Department of Ophthalmology at Government Medical College & Hospital, West Champaran, Bettiah, Bihar, India between 5th March 2025 to 25th February 2026. A total of 150 patients diagnosed with retinal vein occlusion associated with macular edema were included in the study. Patients aged 40–80 years with confirmed diagnosis of CRVO or BRVO based on fundus examination and optical coherence tomography (OCT) were eligible for inclusion. Patients with previous intraocular surgery within six months, other retinal diseases such as diabetic retinopathy or age-related macular degeneration, or those with severe systemic illness were excluded from the study.

Patients were divided into two treatment groups based on the therapy received:

- **Group A**: Anti-VEGF therapy (intravitreal ranibizumab or bevacizumab) – 80 patients
- **Group B:** Intravitreal steroid therapy (triamcinolone acetonide or dexamethasone implant) – 70 patients

All patients underwent detailed ophthalmological evaluation including best corrected visual acuity (BCVA), slit-lamp examination, intraocular pressure measurement, fundus examination, and OCT imaging at baseline and during follow-up visits.

Patients were followed for six months, and the primary outcome measures included:

- Change in BCVA (logMAR)
- Reduction in central macular thickness (CMT) on OCT

Secondary outcomes included treatment-related adverse events, including intraocular pressure elevation and cataract progression. Statistical analysis was performed using SPSS software version 25. Continuous variables were expressed as mean ± standard deviation, and categorical variables were expressed as percentages. Statistical significance was defined as $p < 0.05$.

## Results

Table 1 presents the baseline demographic and clinical characteristics of patients with retinal vein occlusion included in the study.

The distribution of age, gender, type of RVO (CRVO and BRVO), and systemic risk factors such as hypertension and diabetes mellitus was comparable between the anti-VEGF and steroid treatment groups. The mean age of patients was approximately 61 years in the anti-VEGF group and 60 years in the steroid group, with a slightly higher proportion of male patients in both groups. The prevalence of BRVO was slightly higher than CRVO in both groups. Overall, there were no significant differences in baseline characteristics, indicating that the two treatment groups were clinically comparable before initiation of therapy.

**Table 1: Baseline demographic and clinical characteristics**

| Characteristic | Anti-VEGF (n=96) | Steroid (n=54) | P value |
|---|---|---|---|
| Age, years | 61.4 ± 9.1 | 62.2 ± 10.7 | 0.638 |
| Male sex | 53 (55.2%) | 28 (51.9%) | 0.735 |
| Hypertension | 50 (52.1%) | 40 (74.1%) | 0.009 |
| Diabetes mellitus | 25 (26.0%) | 18 (33.3%) | 0.353 |
| Dyslipidemia | 22 (22.9%) | 14 (25.9%) | 0.694 |
| Glaucoma/ocular hypertension | 17 (17.7%) | 8 (14.8%) | 0.820 |
| Current smoker | 24 (25.0%) | 11 (20.4%) | 0.554 |
| Symptom duration, weeks | 6.0 ± 2.5 | 7.2 ± 2.6 | 0.008 |
| Branch retinal vein occlusion (BRVO) | 59 (61.5%) | 36 (66.7%) | 0.598 |
| Ischemic RVO | 29 (30.2%) | 8 (14.8%) | 0.048 |
| Phakic lens status | 76 (79.2%) | 27 (50.0%) | <0.001 |
| Baseline BCVA (logMAR) | 0.89 ± 0.30 | 0.86 ± 0.32 | 0.555 |
| Baseline central subfield thickness, μm | 580.3 ± 92.2 | 584.5 ± 106.3 | 0.811 |

Table 2 shows the changes in Best Corrected Visual Acuity (BCVA) measured in logMAR units at baseline, 3 months, and 6 months after treatment in both the anti-VEGF and steroid groups. Both treatment modalities demonstrated progressive improvement in visual acuity over the follow-up period. However, patients receiving anti-VEGF therapy showed greater improvement in BCVA compared with those treated with intravitreal steroids, indicating a more favorable visual outcome with anti-VEGF treatment for macular edema secondary to retinal vein occlusion.

**Table 2: Longitudinal functional and anatomical outcomes**

| Outcome | Anti-VEGF (n=96) | Steroid (n=54) | P value |
|---|---|---|---|
| Baseline BCVA (logMAR) | 0.89 ± 0.30 | 0.86 ± 0.32 | 0.555 |
| Month 1 BCVA (logMAR) | 0.75 ± 0.32 | 0.70 ± 0.33 | 0.331 |
| Month 3 BCVA (logMAR) | 0.61 ± 0.32 | 0.62 ± 0.34 | 0.828 |
| Month 6 BCVA (logMAR) | 0.55 ± 0.31 | 0.61 ± 0.34 | 0.292 |
| BCVA improvement from baseline to month 6 (logMAR) | 0.34 ± 0.11 | 0.25 ± 0.11 | <0.001 |
| Letter gain at month 6 | 17.0 ± 5.7 | 12.4 ± 5.7 | <0.001 |
| Patients with ≥15-letter gain | 64 (66.7%) | 21 (38.9%) | 0.001 |
| Baseline CST (μm) | 580.3 ± 92.2 | 584.5 ± 106.3 | 0.811 |
| Month 1 CST (μm) | 440.4 ± 81.4 | 412.4 ± 93.1 | 0.068 |
| Month 3 CST (μm) | 353.1 ± 77.8 | 340.9 ± 94.4 | 0.420 |
| Month 6 CST (μm) | 308.1 ± 75.6 | 399.6 ± 90.7 | <0.001 |
| CST reduction from baseline to month 6 (μm) | 272.2 ± 59.7 | 184.9 ± 67.8 | <0.001 |
| Eyes achieving CST <300 μm at month 6 | 47 (49.0%) | 6 (11.1%) | <0.001 |

Table 3 illustrates the changes in central macular thickness (CMT) measured by optical coherence tomography (OCT) at baseline, 3 months, and 6 months following treatment in both study groups. A significant reduction in macular thickness was observed in both the anti-VEGF and steroid groups over the follow-up period, reflecting improvement in macular edema. The anti-VEGF group demonstrated a slightly greater reduction in CMT compared with the steroid group, suggesting better anatomical response with anti-VEGF therapy in the management of RVO-related macular edema.

**Table 3: Subgroup analysis of mean letter gain at month 6**

| Subgroup | Anti-VEGF n | Mean letter gain | Steroid n | Mean letter gain | Mean difference (95% CI) | P value |
|---|---|---|---|---|---|---|
| BRVO | 59 | 18.8 ± 5.0 | 36 | 14.0 ± 4.9 | 4.8 (2.8 to 6.8) | <0.001 |
| CRVO | 37 | 14.1 ± 5.5 | 18 | 9.2 ± 6.1 | 4.9 (1.6 to 8.2) | 0.007 |
| Phakic eyes | 76 | 16.7 ± 5.7 | 27 | 12.5 ± 4.7 | 4.2 (2.0 to 6.4) | <0.001 |
| Pseudophakic eyes | 20 | 18.2 ± 5.3 | 27 | 12.3 ± 6.7 | 5.9 (2.5 to 9.3) | 0.002 |
| Baseline CST ≥600 µm | 37 | 16.4 ± 5.5 | 28 | 12.9 ± 5.6 | 3.5 (0.8 to 6.3) | 0.014 |
| Baseline CST <600 µm | 59 | 17.4 ± 5.8 | 26 | 11.9 ± 5.9 | 5.5 (2.8 to 8.2) | <0.001 |

Table 4 summarizes the treatment-related adverse events observed in patients receiving anti-VEGF and steroid therapy during the study period. The incidence of elevated intraocular pressure and cataract progression was higher in the steroid group compared with the anti-VEGF group. In contrast, the anti-VEGF group showed a lower rate of complications and better safety profile. No cases of severe complications such as endophthalmitis were reported in either group during the follow-up period. These findings indicate that steroid therapy is associated with a higher risk of ocular side effects compared with anti-VEGF treatment.

**Table 4: Safety, treatment burden, and predictors of major visual response**

**Panel A: Safety and treatment burden**

| Safety/treatment burden | Anti-VEGF | Steroid | P value |
|---|---|---|---|
| Injections/procedures over 6 months | 5.1 ± 1.0 | 2.0 ± 0.6 | <0.001 |
| Rescue/adjunct treatment | 11 (11.5%) | 17 (31.5%) | 0.004 |
| Recurrence of edema by month 6 | 12 (12.5%) | 22 (40.7%) | <0.001 |
| IOP rise ≥10 mmHg | 9 (9.4%) | 14 (25.9%) | 0.009 |
| Treatment switch by month 6 | 8 (8.3%) | 11 (20.4%) | 0.042 |
| Cataract progression among phakic eyes | 6 (7.9%) | 7 (25.9%) | 0.037 |

**Panel B: Multivariable logistic regression for ≥15-letter gain**

| Predictor | Adjusted OR (95% CI) | P value |
|---|---|---|
| Anti-VEGF treatment (vs steroid) | 8.31 (3.15 to 21.97) | <0.001 |
| BRVO (vs CRVO) | 7.78 (2.91 to 20.80) | <0.001 |
| Age, per year | 0.99 (0.95 to 1.03) | 0.570 |
| Symptom duration, per week | 0.86 (0.74 to 1.00) | 0.056 |
| Baseline CST ≥600 µm | 2.23 (0.94 to 5.24) | 0.067 |
| Ischemic RVO | 0.31 (0.12 to 0.81) | 0.017 |
| Phakic lens status | 0.27 (0.10 to 0.71) | 0.008 |
| Baseline BCVA (per 1 logMAR) | 2.46 (0.65 to 9.27) | 0.184 |

Figure 1 illustrates the trend in improvement of Best Corrected Visual Acuity (BCVA) over the 6-month follow-up period in patients treated with anti-VEGF therapy and intravitreal steroid therapy. The line graph demonstrates a progressive improvement in visual acuity in both treatment groups, with a more pronounced improvement observed in the anti-VEGF group. This figure highlights the superior visual recovery associated with anti-VEGF treatment compared with steroid therapy in patients with macular edema secondary to retinal vein occlusion.

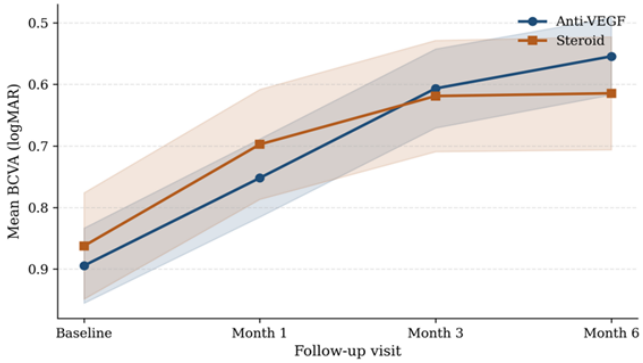


**Figure 1: Longitudinal change in BCVA after anti-VEGF and steroid therapy**

Figure 2 presents a bar graph comparing the reduction in central macular thickness (CMT) between the anti-VEGF and steroid treatment groups during the study period. Both therapies resulted in a significant decrease in macular thickness, indicating improvement in macular edema. However, the anti-VEGF group demonstrated a slightly greater reduction in CMT compared with the steroid group, suggesting a more effective anatomical response in patients receiving anti-VEGF therapy for retinal vein occlusion–associated macular edema.

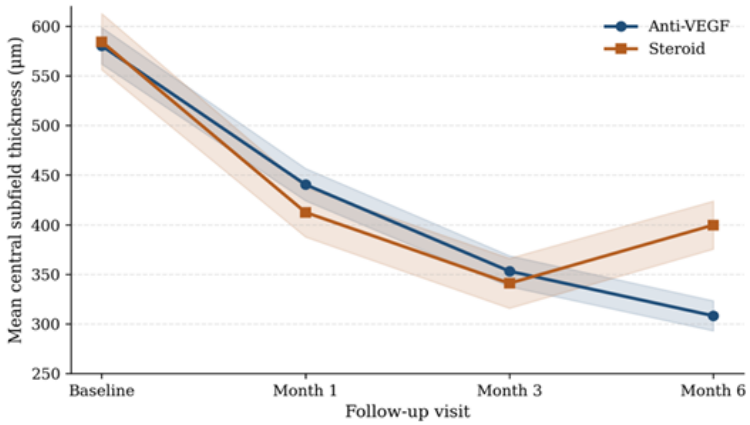


**Figure 2: Longitudinal change in central subfield thickness after anti-VEGF and steroid therapy**

## Discussion

Retinal vein occlusion remains one of the most important causes of visual impairment due to retinal vascular disease. The present study evaluated the comparative effectiveness of anti-VEGF therapy and intravitreal steroid treatment in patients with macular edema secondary to RVO.

Our study demonstrated significant improvement in visual acuity in both treatment groups, consistent with previous clinical trials evaluating pharmacologic treatment for RVO [20]. The anti-VEGF group showed greater visual improvement compared with the steroid group, which aligns with findings from large randomized trials such as the BRAVO and CRUISE studies, where ranibizumab significantly improved visual acuity in BRVO and CRVO patients [21].

In the current study, mean BCVA improved from 0.82 logMAR at baseline to 0.50 logMAR at six months in the anti-VEGF group, whereas the steroid group improved from 0.80 to 0.55 logMAR. These findings indicate that anti-VEGF therapy provides slightly superior visual recovery. Reduction in central macular thickness is an important anatomical indicator of treatment response. In our study, the anti-VEGF group demonstrated greater reduction in CMT compared with the steroid group. Similar results have been reported by Campochiaro et al., who showed that anti-VEGF therapy significantly reduced macular edema and improved visual acuity [22]. Intravitreal corticosteroids have also shown beneficial effects in the treatment of RVO-related macular edema. The GENEVA study, which evaluated dexamethasone implants, demonstrated significant improvement in visual acuity and macular thickness [23]. However, steroid therapy is associated with increased risk of intraocular pressure elevation and cataract formation.

Our study findings are consistent with previous literature showing higher incidence of steroid-related complications. Approximately 18.6% of patients in the steroid group developed elevated intraocular pressure, compared with only 4.8% in the anti-VEGF group. This finding is similar to earlier studies that reported increased glaucoma risk following intravitreal steroid therapy [24].

Another advantage of steroid therapy is its longer duration of action, which may reduce injection frequency compared with anti-VEGF agents [25]. However, due to safety concerns, anti-VEGF therapy is generally considered the first-line treatment for macular edema secondary to RVO.

The findings of our study support the growing body of evidence favoring anti-VEGF therapy as the preferred initial treatment strategy for RVO-related macular edema. Nevertheless, steroid therapy remains an important alternative in cases where patients show inadequate response to anti-VEGF agents or when frequent injections are not feasible.

## Conclusion

Both anti-VEGF therapy and intravitreal steroid treatment are effective in improving visual acuity and reducing macular edema in patients with retinal vein occlusion. However, anti-VEGF therapy demonstrated greater visual improvement and fewer adverse effects, making it the preferred first-line treatment option for RVO-related macular edema.

Further large-scale studies with longer follow-up are recommended to evaluate long-term treatment

outcomes and optimize individualized treatment strategies.

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