Visual Outcomes of Ranibizumab Versus Bevacizumab in Diabetic Retinopathy: An Analytical Study

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ABSTRACT

Introduction: Diabetic retinopathy (DR) is usually treated with Anti-vascular endothelial growth factor (anti-VEGF) agents. Ranibizumab is an approved drug for ocular use, while bevacizumab has also been introduced as an off-label drug for retinal diseases.

Objective: To compare the clinical efficacy and vision related quality of life of ranibizumab and bevacizumab in patients with diabetic retinopathy.

Methodology: An analytical study was conducted from 2024 September to 2025 March in the Department of Ophthalmology, KLE's Prabhakar Kore Hospital and Medical Research Centre, Belagavi. Following ethical clearance, 105 subjects (aged ≥35 years) diagnosed with DR were enrolled by universal sampling and divided into two groups A and B. Clinical efficacy was evaluated using Optical Coherence Tomography and Visual Acuity scores and vision-related quality of life through the National Eye Institute Visual Function Questionnaire, at baseline and third follow-up.

Result: Central macular thickness decreased in both the Ranibizumab and Bevacizumab groups at the end of the treatment period, but the mean reduction was substantially larger in the Ranibizumab group (282.0 ± 193 μm) than in the Bevacizumab group (343.0 ± 233 μm) ($p = 0.040$). In terms of visual acuity, the group that received ranibizumab exhibited a considerably higher improvement in logarithm of minimum angle of resolution scores (0.500 ± 0.4 to 0.22 ± 0.1), while the group that received bevacizumab showed a less noticeable improvement ($p < 0.05$) from (0.60 ± 0.3 to 0.50 ± 0.3). Furthermore, the Ranibizumab group's vision-related quality of life, as measured by the composite score, was significantly higher (64.79 ± 18.01) than the Bevacizumab group's (56.53 ± 17.73), indicating both statistically and clinically significant improvements in the functional and psychosocial domains ($p = 0.020$).

Conclusion: Both anti-VEGF agents were effective and safe in diabetic retinopathy; however, ranibizumab demonstrated superior efficacy, faster response, and shorter treatment duration, reinforcing its value for improving both clinical and patient-centred outcomes.

Key words: Bevacizumab; central macular thickness; national eye institute visual function questionnaire; ranibizumab; visual acuity.

Financial Interest : Nil
Conflict of Interest : Nil

Received : 06.08.2025
Accepted : 17.03.2026
Published : 03.04.2026

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Access this article online
Website: www.nepjol.info/index.php/NEPJOPH
DOI: https://doi.org/10.3126/nepjoph.v18i35.82606

ISSN: 2072-6805, **E-ISSN:** 2091-0320

INTRODUCTION

Diabetic retinopathy (DR) is a common microvascular complication of diabetes mellitus and a leading cause of preventable blindness worldwide (Yau et al., 2012). It results from chronic hyperglycaemia, which leads to pathological neovascularisation (Wei et al., 2022). Diabetic macular oedema (DME) is a major cause of vision loss in DR, occurring at any stage of the disease (Fung et al., 2022). Anti-vascular endothelial growth factor agents are now standard in the management of DR and DME (Fung et al., 2022;Gonzalez-Cortes et al., 2022). These therapies inhibit vascular endothelial growth factor A (VEGF-A), a central mediator of angiogenesis and vascular leakage, reducing macular oedema and preserving visual function (Fung et al., 2022; Gonzalez-Cortes et al., 2022). Ranibizumab is a recombinant monoclonal antibody fragment approved for ocular use, while bevacizumab is a full-length monoclonal antibody approved and used off-label for retinal diseases (Wei et al., 2022). Studies show that ranibizumab and bevacizumab improve best-corrected visual acuity (BCVA) and reduce central macular thickness (CMT) when administered as per intravitreal protocols (Wei et al., 2022; Zhang et al., 2021). These visual improvements are typically assessed using optical coherence tomography (OCT) and are associated with better quality of life, as evaluated by the National Eye Institute Visual Function Questionnaire (NEI VFQ) (Klein, 2001; Nguyen et al., 2023; Hatice Daldal, 2022). Ranibizumab offers advantages in ocular pharmacokinetics and reduced systemic absorption. However, bevacizumab is widely used due to its comparable efficacy in real-world settings (Wei et al., 2022; Gonzalez-Cortes et al., 2022; Zhang et al., 2021). With long-term treatment, both drugs are generally well tolerated, and disease recurrence is manageable with adjusted dosing intervals (Nguyen et al., 2023; Powers et al., 2015). The study aimed to compare the effectiveness of intravitreal ranibizumab and bevacizumab in treating DR, specifically assessing their impact on visual acuity improvement and CMT reduction.

METHODOLOGY

This was a hospital-based, analytical study conducted in the Department of Ophthalmology, KLE's Prabhakar Kore Hospital and Medical Research Centre from 2024 September to 2025 March. Data collection for the study was done for six months after obtaining an ethical clearance from the Institutional Ethics Committee (Reference number: KLECOPBGMEC/D007-2024; Dated: 2024 September 03). All patients aged ≥35 years diagnosed with diabetic retinopathy were enrolled in the study by universal sampling. Those with pregnancy, lactation, psychiatric condition, infectious disease, previous ocular surgery, and presence of other ocular disease were excluded from the study and inclusion criteria were proliferative and non-proliferative forms of diabetic retinopathy, with or without accompanying DME. Subjects were enrolled after obtaining written informed consent and were classified according to the treatment drug which was prescribed and administered by the attending ophthalmologist as part of their routine clinical care. A total of 105 subjects were enrolled, 56 in ranibizumab group and 49 in bevacizumab group assigned as group A and B respectively. The sample size was based on the number of patients meeting the eligibility criteria during the study period.

As per standard ophthalmological protocol, patients received intravitreal Ranibizumab at a dose of 0.5 mg once monthly (30 days) (Chong, 2015), whereas Bevacizumab was administered at 1.25 mg every four weeks (Wells et al., 2015). Baseline data were collected before the initial intravitreal injection, and patients were subsequently monitored through scheduled follow-up visits. Detailed clinical and personal data were collected using subject specific data collection form, which included demographic details, and vision-related assessments. Visual function was evaluated using Optical Coherence Tomography and Visual Acuity, while the impact on daily life and well-being was assessed through the National Eye Institute Visual Function Questionnaire-25. All collected data were carefully organised and analysed using Microsoft Excel Sheet and IBM SPSS Statistics for Windows, version 20.0 (IBM Corp., Armonk, N.Y., USA) software. A range of statistical tests including the Chi-square test, Mann-Whitney U test, Wilcoxon Signed-Rank test, and Spearman rank correlation were applied across various clinical measures.

RESULT

A total of 105 participants were enrolled in this analytical study, 56 (53.3%) were given ranibizumab (Group A) and 49 (46.7%) were given bevacizumab (Group B). The central macular thickness, visual acuity, and vision-related quality of life levels of the Ranibizumab group improved more than those of the Bevacizumab group by the third follow-up. The baseline mean central macular thickness was higher in the Bevacizumab group (367.0 ± 242 μm) than in the Ranibizumab group (343.5 ± 213.5 μm), but this difference was not statistically significant (p-value = 0.130). At the third follow-up, the central macular thickness was significantly lower in the Ranibizumab group (282.0 ± 193 μm) than in the Bevacizumab group (343.0 ± 233 μm; p-value = 0.040) (Table 1). Visual acuity improved in both groups; however, the Ranibizumab group's logMAR scores decreased more significantly from 0.50 to 0.22 than the Bevacizumab group (0.60 to 0.50). This difference, favouring Ranibizumab at the third follow-up, was statistically significant (p-value <0.05) (Table 1).

Both groups demonstrated gradual improvements in vision-related quality of life as measured by the NEI VFQ-25 total score. The mean score at baseline was 40.71 ± 11.58 for the Ranibizumab group and 37.31 ± 10.36 for the Bevacizumab group (p-value = 0.117). At the third follow-up, the Ranibizumab group scored 64.79 ± 18.01, which was significantly more than the Bevacizumab group's score of 56.53 ± 17.73 (p-value = 0.020) (Table 2).

Significant progress was observed in a number of distinct NEI VFQ-25 domains (Table 3). By the third follow-up, both groups demonstrated statistically significant improvements in general health, general vision, near activity, distance activity, colour vision, peripheral vision, mental health, role difficulties, dependency, driving, and social function (p-value <0.05, Wilcoxon signed-rank test), even though not all domains showed significant inter-group differences at baseline (p-value >0.05).

But at the third follow-up, the Ranibizumab group outperformed the Bevacizumab group in the following domains: Dependency (p-value = 0.035), Near activity (p-value = 0.001), Colour

vision (p-value = 0.001), Peripheral vision (p-value = 0.008), and General vision (p-value <0.05). Other domains, such as mental health, role difficulties, driving, and social function also improved significantly within both groups but did not show significant differences between groups (p-value >0.05) (Table 3).

Correlation analysis (Table 4) in the Bevacizumab group revealed a significant negative correlation between logMAR and NEI VFQ-25 score (r = -0.381; p-value = 0.007), indicating that better visual acuity was associated with improved vision-related quality of life. Additionally, a significant negative correlation was observed between CMT and NEI VFQ-25 in the Bevacizumab group (r = -0.619; p-value <0.05). No significant correlations were observed in the Ranibizumab group (p-value >0.05).

Demographic and clinical characteristics of subjects were similar between groups (Table 5). The majority of patients were aged 60–71 years, including 24 (42.8%) in the Ranibizumab group and 22 (44.8%) in the Bevacizumab group. Most patients were male: 36 (64.3%) in the Ranibizumab group and 38 (77.6%) in the Bevacizumab group. Diabetic macular oedema was present in 38 (67.9%) of those receiving Ranibizumab and 31 (63.3%) receiving Bevacizumab.

Table 1: Comparison of central macular thickness and visual acuity (logMAR) between ranibizumab and bevacizumab groups.

Parameter	Time-point	Ranibizumab (n = 56) Median (IQR)	Bevacizumab (n = 49) Median (IQR)	p-value
Central macular thickness (µm)	Baseline	343.5 (213.5)	367.0 (242.0)	0.130
	Follow-up	282.0 (193.0)	343.0 (233.0)	0.040*
	Within-group p-value	<0.05*	<0.05*	
Visual acuity (logMAR)	Baseline	0.500 (0.4)	0.600 (0.3)	0.061
	Follow-up	0.220 (0.1)	0.500 (0.3)	<0.05*
	Within-group p-value	<0.05*	<0.05*	

*Statistically significant at p <0.05

Table 2: Comparison of NEI VFQ-25 outcomes for ranibizumab and bevacizumab at baseline and follow-up.

Visual acuity score	Ranibizumab (n = 56) Mean ± SD	Bevacizumab (n = 49) Mean ± SD	p-value
Baseline	40.7 ± 11.5	37.3 ± 10.3	0.117
At follow-up	64.7 ± 18.0	56.5 ± 17.7	0.020*

*Significant at p<0.05

Table 3: NEI VFQ-25 vision-related quality of life scores.

Domain	Time-point	Ranibizumab (n = 56) Median (IQR)	Bevacizumab (n = 49) Median (IQR)	p-value
General health	Baseline	25.0 (25.0)	50.0 (25.0)	0.021
	Follow-up	50.0 (25.0)	50.0 (25.0)	<0.05*
General vision	Baseline	40.0 (40.0)	40.0 (0.0)	0.954
	Follow-up	80.0 (20.0)	60.0 (40.0)	<0.05*
Ocular pain	Baseline	50.0 (25.0)	37.5 (12.5)	0.179
	Follow-up	75.0 (25.0)	62.5 (37.5)	0.006*
Near activities	Baseline	33.3 (25.0)	33.3 (16.7)	0.917
	Follow-up	58.3 (25.0)	58.3 (33.3)	0.001*
Distance activities	Baseline	33.3 (16.7)	33.3 (8.3)	0.449
	Follow-up	66.7 (16.7)	58.3 (33.3)	0.003*
Social functioning	Baseline	37.5 (25.0)	37.5 (12.5)	0.768
	Follow-up	62.5 (25.0)	62.5 (37.5)	0.854
Mental health	Baseline	40.6 (18.8)	37.5 (18.8)	0.283
	Follow-up	62.5 (15.6)	56.3 (37.5)	0.196
Role difficulties	Baseline	50.0 (25.0)	37.5 (25.0)	0.380
	Follow-up	62.5 (25.0)	62.5 (37.5)	0.738
Dependency	Baseline	41.6 (25.7)	33.3 (16.7)	0.109
	Follow-up	66.7 (16.7)	58.3 (33.3)	0.035*
Driving	Baseline	33.3 (41.7)	25.0 (33.3)	0.149
	Follow-up	50.0 (62.5)	33.3 (66.7)	0.076
Colour vision	Baseline	50.0 (25.0)	50.0 (25.0)	0.601
	Follow-up	75.0 (12.0)	75.0 (25.0)	0.001*
Peripheral vision	Baseline	50.0 (25.0)	25.0 (25.0)	0.131
	Follow-up	75.0 (0.0)	50.0 (25.0)	0.008*

Table 4: Correlation of visual outcomes with NEI VFQ-25 scores.

Variables Correlated	Ranibizumab (n = 56) Correlation (r)	p-value	Bevacizumab (n = 49) Correlation (r)	p-value
Log MAR Vs NEI VFQ-25	–0.210	0.12	–0.381	0.007*
Central macular thickness Vs NEI VFQ-25	–0.110	0.42	–0.619	<0.05*

*Significant at p <0.05

Table 5: Patient demographics.

Characteristic	Category	Ranibizumab (n = 56)	Bevacizumab (n = 49)
Age (years)	36 – 47	8 (14.2 %)	10 (20.4 %)
	48 – 59	20 (35.7 %)	15 (30.6 %)
	60 – 71	24 (42.8 %)	22 (44.8 %)
	72 – 83	4 (7.1 %)	2 (4.0 %)
Gender	Male	36 (64.3 %)	38 (77.6 %)
	Female	20 (35.7 %)	11 (22.4 %)
Diabetic macular oedema	No	18 (32.1 %)	18 (36.7 %)
	Yes	38 (67.9 %)	31 (63.3 %)

DISCUSSION

In this study comparing Ranibizumab and Bevacizumab for reducing retinal swelling, Ranibizumab demonstrated a clear advantage. At the final follow-up, patients treated with Ranibizumab had a significantly thinner central retina (median thickness of 282 µm) compared to those treated with Bevacizumab (343 µm). This difference indicates that Ranibizumab is more effective at reducing retinal oedema and restoring normal retinal structure a finding consistent with earlier landmark trials like MARINA and ANCHOR, which showed Ranibizumab's strong ability to prevent leakage and abnormal blood vessel growth in eye diseases (Brown et al., 2006; Mitchell et al., 2011; Nguyen et al., 2012).

Both drugs improved patients' vision, but Ranibizumab led to a bigger improvement. By the study's end, the median vision score (LogMAR)) was 0.22 for the Ranibizumab group versus 0.50 for the Bevacizumab group, signifying better functional vision for those on Ranibizumab. These results align with the DRCR.net Protocol T study, which found that Ranibizumab especially benefited patients with worse vision at the start (Wells et al., 2016; Heier et al., 2012).

Visual function plays a key role in shaping patients daily experiences and emotional well-being. The study assessed quality of life using the NEI VFQ-25 questionnaire, a validated tool that measures how vision problems affect real-world functioning (Chang, 2007). While both treatment groups showed improvements, patients receiving Ranibizumab consistently reported higher quality of life scores. By the third follow-up, approximately 82% of patients treated with Ranibizumab indicated a moderate to high quality of life, compared to around 65% in the Bevacizumab group. These findings highlight that Ranibizumab not only improves clinical measures of vision but also offers broader, meaningful benefits to patients' everyday lives.

In the Bevacizumab group, significant negative correlations were observed between macular thickness and QOL ($R = -0.619$, $p<0.05$), and

between LOGMAR and QOL (R = -0.381, p = 0.007). This suggests that reductions in retinal swelling and improvements in visual clarity contributed directly to enhanced daily living and mental well-being. In the Ranibizumab group, the lack of significant correlations might be explained by a ceiling effect many patients had already reported high quality-of-life scores, leaving little room for further measurable improvement. These findings are supported by previous literature showing that visual acuity is a key predictor of health-related quality of life in patients with retinal disease (Mangione et al., 2001). Not many studies have compared these two drugs by looking only at how well they work in real patients. This study does that by focusing on improvements in vision and central macular thickness.

CONCLUSION

This analytical study of Ranibizumab and Bevacizumab in patients with diabetic retinopathy demonstrated that Ranibizumab offers superior clinical efficacy in reducing central retinal thickness and enhancing visual acuity. Patients receiving Ranibizumab showed a greater reduction in retinal swelling and a more substantial improvement in vision compared to those treated with Bevacizumab, findings that echo the outcomes of prior landmark trials. Moreover, improvements in vision were directly associated with better quality-of-life outcomes, particularly in the Bevacizumab group, suggesting that anatomical and functional gains translate meaningfully into patients' daily experiences.

While both drugs improved quality of life, Ranibizumab recipients consistently reported higher scores, reflecting a broader impact beyond clinical parameters. However, this study's findings should be interpreted within the context of its limitations, including a small sample size and a relatively short follow-up duration. Future research with larger, more diverse populations and longer observation periods is warranted to confirm these results and assess long-term outcomes. Overall, this study reinforces the value of Ranibizumab as a more effective treatment option for improving both clinical and patient-centred outcomes in diabetic retinopathy.

ACKNOWLEDGEMENTS

The authors express their sincere gratitude to the Department of Ophthalmology at KLE's Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi, for their support and cooperation. The authors also thank the National Eye Institute (NEI), a branch of the National Institute of Health (NIH), for providing the NEI VFQ-25, a quality of life questionnaire related to vision.

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