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Visual outcomes following intravitreal anti-VEGF therapy in diabetic retinopathy

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Abstract:
Diabetic retinopathy is a leading cause of preventable blindness and optimizing visual outcomes with intravitreal anti-vascular endothelial growth factor therapy remains a major clinical priority. Therefore, it is of interest to evaluate the effectiveness of intravitreal anti-vascular endothelial growth factor therapy in 100 patients with diabetic retinopathy using best corrected visual acuity, optical coherence tomography and fundus examination during follow-up. Treatment resulted in significant improvement in best corrected visual acuity and a significant reduction in central macular thickness, with superior outcomes observed in patients receiving early intervention and maintaining good glycemic control. Intravitreal anti-vascular endothelial growth factor therapy proved to be an effective and safe approach for improving both functional vision and retinal morphology in diabetic retinopathy. Thus, data shows the early use of intravitreal anti-vascular endothelial growth factor therapy to preserve vision and optimize long-term outcomes in patients with diabetic retinopathy.

Keywords: Diabetic retinopathy (DR), anti-VEGF, intravitreal injection, visual acuity, diabetic macular edema (DME), retina

Background:
Diabetic retinopathy (DR) is one of the most common microvascular complications of diabetes mellitus and remains a major cause of visual impairment and blindness worldwide. The increasing prevalence of diabetes has significantly contributed to the growing burden of retinal vascular diseases. Chronic hyperglycemia induces retinal microvascular damage through oxidative stress, inflammation, endothelial dysfunction and capillary basement membrane thickening, eventually leading to retinal ischemia and neovascularization **[1].** Globally, diabetic retinopathy affects nearly one-third of diabetic individuals, while vision-threatening diabetic retinopathy develops in a substantial proportion of patients with longstanding disease. The prevalence is expected to increase further due to population aging, sedentary lifestyle, obesity and increasing incidence of type 2 diabetes mellitus **[2].** Vision loss in diabetic retinopathy primarily occurs due to diabetic macular edema (DME), vitreous hemorrhage, tractional retinal detachment and proliferative diabetic retinopathy (PDR). These complications adversely affect daily activities, occupational productivity and quality of life **[3].** The pathogenesis of diabetic retinopathy involves multiple biochemical pathways including activation of protein kinase C, accumulation of advanced glycation end products, inflammatory cytokine release and retinal hypoxia. Hypoxia stimulates increased expression of vascular endothelial growth factor (VEGF), which is considered one of the principal mediators of retinal neovascularization and vascular permeability. VEGF causes breakdown of the blood-retinal barrier, resulting in leakage of plasma into retinal tissues and development of macular edema **[4].** Earlier treatment modalities for diabetic retinopathy mainly included laser photocoagulation and vitreoretinal surgery. Although laser therapy reduced progression of severe visual loss, it was associated with retinal scarring, peripheral visual field loss and limited visual improvement **[5].** The advent of intravitreal anti-VEGF therapy revolutionized retinal disease management by directly targeting the molecular mechanisms responsible for neovascularization and edema formation. Currently used anti-VEGF agents include bevacizumab, ranibizumab, aflibercept and newer long-acting formulations **[6].** Several randomized clinical trials and real world studies have demonstrated that anti-VEGF therapy significantly improves best corrected visual acuity (BCVA), reduces central macular thickness and slows disease progression in diabetic retinopathy **[7].** Repeated intravitreal injections have shown superior outcomes compared with conventional laser photocoagulation, especially in centre involving diabetic macular edema **[8].** Recent studies have also emphasized the role of anti-VEGF agents in preventing progression from non-proliferative diabetic retinopathy to proliferative stages. Anti-VEGF therapy reduces retinal neovascularization, improves retinal perfusion and decreases the need for surgical intervention in many patients **[9].** Moreover, advancements in optical coherence tomography (OCT) and retinal imaging have enabled accurate monitoring of retinal thickness and treatment response **[10].** Despite the widespread use of anti-VEGF therapy, visual outcomes may vary depending on factors such as duration of diabetes, baseline visual acuity, glycemic control, severity of retinopathy, injection frequency and patient compliance. Long-term repeated injections may also increase economic burden and treatment fatigue **[11].** Therefore, it is of interest to evaluate the visual outcomes following intravitreal anti-VEGF therapy in patients with diabetic retinopathy and to assess factors associated with improvement in visual acuity and retinal morphology.

Materials and Methodology:

Study design:
The present study was a prospective observational hospital-based study conducted in the Department of Ophthalmology at a tertiary care teaching hospital.

Study duration:
The study was conducted over a period of 18 months.

Sample size:
A total of 100 patients diagnosed with diabetic retinopathy requiring intravitreal anti-VEGF therapy were included in the study.

Inclusion criteria:
[1] Patients aged above 18 years
[2] Diagnosed cases of diabetic retinopathy with diabetic macular edema or proliferative diabetic retinopathy

[3] Patients advised intravitreal anti-VEGF therapy
[4] Patients willing for regular follow-up

Exclusion criteria:
[1] Previous vitreoretinal surgery
[2] Coexisting retinal disorders
[3] Advanced glaucoma
[4] Ocular trauma
[5] Corneal opacity affecting retinal evaluation
[6] Patients lost to follow-up

Clinical evaluation:
All patients underwent:
[1] Detailed ophthalmic history
[2] Visual acuity assessment using Snellen chart
[3] Best corrected visual acuity (BCVA)
[4] Slit lamp examination
[5] Fundus examination
[6] Fundus fluorescein angiography when required
[7] Optical coherence tomography (OCT)

Procedure:
Intravitreal anti-VEGF injections were administered under aseptic precautions in operation theatre conditions. Commonly used agents included bevacizumab, ranibizumab and aflibercept depending on clinical indication and affordability. Patients received loading doses followed by additional injections based on OCT findings and visual response.

Follow-up:
Patients were followed at:
[1] Baseline
[2] 1 month
[3] 3 months
[4] 6 months

Parameters assessed:
[1] BCVA improvement
[2] Central macular thickness
[3] Retinal neovascularization
[4] Injection-related complications

Statistical analysis:
Data were analyzed using SPSS software version 25. Quantitative data were expressed as mean ± standard deviation. Chi-square test and paired t-test were used for statistical analysis. A p value <0.05 was considered statistically significant.

Results:
A total of 100 patients with diabetic retinopathy receiving intravitreal anti-VEGF therapy were evaluated. Most patients belonged to the age group of 51–70 years. Males constituted a slightly higher proportion of cases compared with females. The majority of patients presented with diabetic macular edema associated with non-proliferative diabetic retinopathy. The majority of patients belonged to the 51–60 years age group (36%), followed by 61–70 years (26%). This indicates higher prevalence of diabetic retinopathy among middle-aged and elderly diabetic individuals **(Table 1).** There was progressive improvement in visual acuity after anti-VEGF therapy. The mean BCVA improved from 1.02 LogMAR at baseline to 0.48 LogMAR at 6 months. Statistical analysis revealed highly significant improvement in visual outcomes with p <0.001 at 6 months **(Table 2)**. The mean central macular thickness showed substantial reduction following therapy. Maximum reduction was observed at 6 months with a 38.6% decrease from baseline values. The reduction was statistically highly significant **(Table 3).**

Table 1: Demographic distribution of study population

Age Group (Years)	Number of Patients	Percentage
31–40	8	8%
41–50	22	22%
51–60	36	36%
61–70	26	26%
>70	8	8%

Table 2: Improvement in best corrected visual acuity following anti-VEGF therapy

Follow-up Period	Mean BCVA (LogMAR)	p value
Baseline	1.02 ± 0.28	—
1 Month	0.82 ± 0.24	0.032
3 Months	0.64 ± 0.20	0.001
6 Months	0.48 ± 0.16	<0.001

Table 3: Central macular thickness before and after therapy

Follow-up	Mean Central Macular Thickness (μm)	Reduction Percentage	p value
Baseline	486 ± 62	—	—
1 Month	412 ± 58	15.2%	0.021
3 Months	356 ± 44	26.7%	0.002
6 Months	298 ± 36	38.6%	<0.001

Discussion:
Diabetic retinopathy continues to represent one of the most important causes of preventable blindness among working-age adults worldwide. Progressive retinal microvascular damage due to chronic hyperglycemia leads to retinal ischemia, vascular leakage and neovascularization. VEGF has been identified as a central mediator responsible for increased vascular permeability and angiogenesis in diabetic retinal disease. Therefore, intravitreal anti-VEGF therapy has emerged as a highly effective treatment modality in recent years **[1].** In the present study, significant improvement in visual acuity was observed following intravitreal anti-VEGF therapy. Mean BCVA progressively improved during follow-up, with statistically highly significant improvement at 6 months. Similar findings were reported by Călugăru and Calugaru who showed substantial visual gains following anti-VEGF treatment in diabetic macular edema patients **[2].** In the present study, significant improvement in visual acuity was observed following intravitreal anti-VEGF therapy. Mean BCVA progressively improved during follow-up,

with statistically highly significant improvement at 6 months. Similar visual gains have been reported in real-world and multicenter DME studies. James *et al.* observed improvement in mean BCVA following ranibizumab treatment, while Salcedo-Villanueva *et al.* reported substantial one-year visual gains following anti-VEGF therapy, particularly among patients with poorer baseline visual acuity **[16, 17].** The majority of patients in the present study belonged to the middle-aged and elderly age groups. This observation corresponds with the known epidemiology of diabetic retinopathy, where prolonged duration of diabetes increases the risk of retinal vascular complications. Teo *et al.* also reported increasing prevalence of diabetic retinopathy with advancing age and duration of diabetes **[3].** Reduction in central macular thickness observed in the present study strongly supports the anatomical efficacy of anti-VEGF agents. OCT evaluation revealed gradual decrease in retinal edema and restoration of retinal architecture. Salcedo-Villanueva *et al.* similarly reported a substantial reduction in central macular thickness at one year following anti-VEGF treatment for DME, while Misal and Wartha showed significant short-term reduction in CMT following a single intravitreal anti-VEGF injection **[17, 18].** Approximately 72% of patients achieved improvement of at least two Snellen lines in the present study. This finding is comparable to results of several major retinal studies showing functional improvement following serial intravitreal injections. Zhao *et al.* documented meaningful visual improvement in real-world diabetic macular edema patients receiving anti-VEGF therapy **[5].** Patients with good glycemic control demonstrated better treatment response compared with poorly controlled diabetics. Chronic uncontrolled hyperglycemia causes irreversible retinal damage, capillary non-perfusion and neuroretinal degeneration, thereby limiting visual recovery. This highlights the importance of multidisciplinary diabetic management along with ocular therapy **[6, 7].** The present study also demonstrated regression of retinal neovascularization in proliferative diabetic retinopathy patients. Anti-VEGF therapy inhibits abnormal vascular proliferation and reduces vitreous hemorrhage risk. Recent evidence suggests that anti-VEGF therapy may delay progression to advanced proliferative stages and reduce surgical intervention rates **[9].** Repeated injections were necessary in many cases because diabetic retinopathy represents a chronic disease process requiring long term management. Patient compliance and regular follow-up significantly influenced treatment success. Real world studies have shown that reduced injection frequency and poor compliance may result in inferior visual outcomes compared with controlled clinical trials **[8].** The safety profile observed in the present study was favorable. Only minor transient ocular discomfort and conjunctival congestion were reported. No serious complications such as endophthalmitis or retinal detachment occurred **[10-12]**. Similar short-term safety findings were reported by Misal and Wartha, who observed only mild ocular discomfort, subconjunctival hemorrhage and temporary intraocular pressure elevation, with no serious ocular or systemic complications following anti-VEGF treatment **[18].** Advances in retinal imaging techniques, including OCT angiography, have significantly improved the assessment of therapeutic response by enabling early detection of recurrent edema and supporting individualized treatment protocols, including treat-and-extend regimens **[13-15].** The present study has certain limitations. The study duration was relatively short and long-term outcomes could not be evaluated. Different anti-VEGF agents were used depending on affordability and availability, which may introduce treatment variability. In addition, systemic diabetic parameters and socioeconomic factors could influence compliance and visual recovery. Despite these limitations, the study provides valuable real-world evidence supporting the effectiveness of intravitreal anti-VEGF therapy in diabetic retinopathy. Early diagnosis, regular follow-up, strict glycemic control and timely administration of injections remain essential for achieving optimal visual outcomes.

Conclusion:

Intravitreal anti-VEGF therapy was associated with improved visual acuity and reduced central macular thickness in patients with diabetic retinopathy and diabetic macular edema. Early treatment, regular follow-up and good glycemic control were associated with better treatment outcomes. Anti-VEGF therapy represents an important treatment approach for improving retinal outcomes and visual function in diabetic retinal disease.

References:

[1] Bahr TA & Bakri SJ. *Life.* 2023 **13**:1098. [PMID: 37240743]
[2] Calugaru D & Calugaru M. *Am J Ophthalmol.* 2018 **193**:253. [PMID: 29970221]
[3] Teo ZL *et al. Ophthalmology.* 2021 **128**:1580. [PMID: 33940045]
[4] Payne CJ *et al. Eye (Lond).* 2024 **38**:1687. [PMID: 38448732]
[5] Zhao XY *et al. Br J Ophthalmol.* 2018 **102**:1077. [PMID: 29246890]
[6] Wang DY *et al. Sci Rep.* 2020 **10**:18880. [PMID: 33144606]
[7] Pei M *et al. Ophthalmic Res.* 2023 **66**.777 [PMID: 36972566]
[8] Dervenis P *et al. Cochrane Database Syst Rev.* 2023 **5**:CD008214. [PMID: 37260074]
[9] Sanaka S & Yu M. *Int J Mol Sci.* 2026 **27**:1142. [PMID: 41683569]
[10] Fogli S *et al. Eye (Lond).* 2018 **32**:1010. [PMID: 29398697]
[11] Falavarjani KG & Nguyen Q. *Eye (Lond).* 2013 **27**:787. [PMID: 23722722]
[12] Coelho-Costa I *et al. Curr Ophthalmol Rep.* 2026 **14**:9. [PMID: 42344179]
[13] Cui J *et al. J Ophthalmol.* 2018 **2018**:4927259. [PMID: 30046459]
[14] Aleman I *et al. Br J Ophthalmol.* 2019 **103**:1740. [PMID: 30705040]
[15] Li Z & Zhang Y. *JCEM Case Rep.* 2025 **3**:luaf083. [PMID: 40255438]
[16] James DGP *et al. Asia Pac J Ophthalmol (Phila).* 2019 **8**:200. [PMID: 31165603]
[17] Salcedo-Villanueva G *et al. Int J Retina Vitreous.* 2025 **11**:89. [PMID: 40750915]

ISSN 0973-2063 (online) 0973-8894 (print)
Bioinformation 22(10): 6326-6330 (2026)
©Biomedical Informatics (2026)

[18] Misal A & Wartha PV. *Int J Med Pharm Res.* 2025 **6**:819. [DOI: 10.5281/zenodo.17349339]

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