

Prophylactic Intravitreal Bevacizumab before Cataract Surgery in Diabetics: Effect on Postoperative Macular Thickness

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Usman Rasheed¹, Zeeshan Hameed², Ali Hassan Iqbal³, Aqsa Baloch⁴, Ayesha Ali⁵

^{1,2,3}M. Islam Teaching Hospital, Gujranwala ^{4,5}Gujranwala Medical College Teaching Hospital, Gujranwala

ABSTRACT

Purpose: To assess whether preoperative intravitreal bevacizumab reduces central macular thickness after phacoemulsification in patients with diabetes.

Study Design: Quasi Experimental Study.

Place and Duration of study: Department of Ophthalmology, Gujranwala Medical College from March 2023 to September 2023.

Methods: Ninety diabetic patients aged 30–55 years scheduled for phacoemulsification were enrolled in this study. Participants were assigned 1:1 to receive 1.25mg/0.1ml intravitreal bevacizumab one week before phacoemulsification or to undergo phacoemulsification without injection. Patients having complicated cataracts and any stage of diabetic retinopathy including clinically significant macular edema were excluded. Spectral-domain OCT measured central macular thickness at baseline and 30 days postoperatively. Analysis used SPSS v25. Statistical significance was set at $p \leq 0.05$.

Results: Study included 19 males and 71 females. Baseline thickness did not differ between groups. On day 30, mean thickness was $254.98 \pm 8.12 \mu\text{m}$ in the bevacizumab group versus $279.27 \pm 7.22 \mu\text{m}$ in the control group, $p < 0.0001$. The difference remained significant across age, sex, and comorbidity subgroups.

Conclusion: Preoperative bevacizumab significantly limited postoperative macular thickening in diabetic patients undergoing cataract surgery.

Keywords: Diabetic Macular Edema, Bevacizumab, Phacoemulsification, Optical Coherence Tomography, Cataract, Vascular Endothelial Growth Factor.

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Correspondence: Usman Rasheed
M. Islam Teaching Hospital, Gujranwala
Email: drusmanbhatti70@gmail.com

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INTRODUCTION

The global rise in diabetes mellitus represents a major public health burden. Global estimates indicate more

than 530 million adults living with diabetes in 2021, with projections exceeding 780 million by 2045.¹ Prolonged hyperglycaemia damages small and large vessels, producing complications that account for substantial morbidity and mortality. Diabetic retinopathy is the most frequent microvascular complication and remains a leading cause of visual impairment in adults of working age.²

Diabetic macular edema develops when the integrity of the inner blood-retinal barrier is compromised, allowing plasma and proteins to leak

into the macula.³ Fluid accumulation distorts the retinal architecture and impairs central vision. The process is driven by elevated levels of vascular endothelial growth factor, alongside inflammatory mediators and chemokines that weaken endothelial tight junctions.⁴ DME may arise in non-proliferative, proliferative, or clinically significant forms, and can occur at any stage of retinopathy.⁵

Cataract formation is accelerated in diabetic individuals and often requires surgical intervention earlier than in non-diabetic populations.⁶ Modern phacoemulsification yields excellent visual outcomes, yet surgery in diabetics carries a higher incidence of postoperative macular edema.⁷ Surgical manipulation induces release of prostaglandins, cytokines, and VEGF, which transiently disrupt the blood-retinal barrier and promote fluid ingress into the macular region.⁸

For decades, focal and grid laser photocoagulation was the standard treatment for DME, as demonstrated by the Early Treatment Diabetic Retinopathy Study.⁹ While effective for focal leakage, laser therapy has limited efficacy in diffuse edema and can cause collateral retinal damage. The introduction of intravitreal drugs has shifted management toward pharmacologic control of vascular permeability and inflammation. Intravitreal corticosteroids reduce edema but carry risks of cataract progression and intraocular pressure elevation.¹⁰ Despite accumulating evidence, practice patterns vary. Some surgeons use preoperative anti-VEGF only in eyes with overt DME, while others consider routine prophylaxis for all diabetic cataract cases. Robust, locally derived randomized data are needed to inform guidelines.

This study was conducted to determine whether preoperative intravitreal bevacizumab lowers postoperative central macular thickness in diabetic patients undergoing phacoemulsification. We tested the hypothesis that a single preoperative injection would produce a lower mean thickness at 30 days compared with surgery alone.

METHODS

A single-centre, parallel-group, quasi experimental study was performed in Gujranwala Medical College from March 2023 to September 2023. Institutional Review Board approval (**No. 19-23/GMC**) was obtained. Written informed consent was secured from all participants. The study followed the Declaration of

Helsinki. Ninety patients with type 2 diabetes and visually significant cataract were included. Eligibility required age 30–55 years, best-corrected visual acuity of $\leq 6/18$, central macular thickness of $>300 \mu\text{m}$ on OCT, and adequate media clarity for imaging. Exclusion criteria comprised proliferative diabetic retinopathy, prior vitrectomy, uveitis, glaucoma, ocular trauma, and intravitreal injections within the preceding three months.

Using OpenEpi software, the sample size was based on prior data showing mean central macular thickness of $267.3 \pm 31.8 \mu\text{m}$ with bevacizumab versus $293.6 \pm 53.7 \mu\text{m}$ without.¹¹ With 95% confidence and 80% power, 45 eyes per group were required. Participants were divided into two groups 1:1. Group A received 1.25 mg/0.05 ml intravitreal bevacizumab under sterile conditions one week preoperatively. Group B proceeded directly to phacoemulsification. All procedures were performed by same surgeon using standard phacoemulsification and intraocular lens implantation.

The primary endpoint was central macular thickness measured by OPTOVUE iScan® spectral-domain OCT at baseline and 30 days postoperatively. Secondary endpoints included best-corrected visual acuity and adverse events. OCT acquisition was performed by a technician masked to group allocation. Demographic variables, duration of diabetes, HbA1c, and comorbidities were recorded. Data were analysed in SPSS v25. Continuous variables were reported as mean $\pm$ standard deviation; categorical variables were presented in percentages. Independent t-tests compared postoperative thickness between groups. Chi-square tests assessed categorical differences. Subgroup analyses examined age, sex, and comorbidity. Statistical significance was set at $p \leq 0.05$.

RESULTS

All 90 participants completed follow-up. Mean age was 43.56 ± 6.22 years, with 64.4% aged 30–45 years. Females accounted for 78.9% of the sample. Hypertension was the most common comorbidity, present in 33.3%. Baseline characteristics were balanced between groups.

Baseline mean central macular thickness was same in both groups but at 30 days, the mean reduction from baseline was $85.71 \mu\text{m}$ in Group A and $11.64 \mu\text{m}$ in Group B (**Table 1**).

Table 1: Comparison of the mean macular thickness after cataract surgery with preoperative anti VEGF (bevacizumab) injection in comparison with control group.

	Group A (n=45)Mean ± SD	Group B (n=45)Mean ± SD	p-value
Baseline macular thickness (µm)	290.71 ± 5.25	290.91 ± 5.11	0.855
Post-operative macular thickness (µm)	254.98 ± 8.12	279.27 ± 7.22	0.0001

Table 2: Stratification of Macular Thickness with respect to age and comorbidity.

		Group A (n=45)		Group B (n=45)		P-value
		Macular Thickness (Mean±SD)		Macular Thickness(Mean±SD)		
Age (years)	30-45	256.33	8.08	288.91	7.52	0.0001
	46-55	253.43	8.07	290.36	6.39	0.0001
Comorbidity	Yes	252.83	7.44	289.50	6.48	0.0001
	No	258.88	8.05	289.16	7.63	0.0001

For participants aged 30–45 years, postoperative thickness was 256.33 ± 8.08 µm with bevacizumab versus 288.91 ± 7.52 µm without, $p < 0.0001$. In those aged 46–55 years, values were 253.43 ± 8.07 µm versus 290.36 ± 6.39 µm, $p < 0.0001$ (**Table 2**).

Among males, postoperative thickness was 258.20 ± 5.85 µm in Group A versus 291.33 ± 6.58 µm in Group B, $p < 0.0001$. Among females, values were 254.06 ± 8.50 µm versus 288.75 ± 7.37 µm, $p < 0.0001$.

In participants with comorbidity, thickness was 252.83 ± 7.44 µm with bevacizumab versus 289.50 ± 6.48 µm without, $p < 0.0001$. In those without comorbidity, values were 258.88 ± 8.05 µm versus 289.16 ± 7.63 µm, $p < 0.0001$ (**Table 2**). No cases of endophthalmitis, retinal detachment, or sustained intraocular pressure rise occurred during follow-up.

DISCUSSION

This study shows that a single preoperative intravitreal bevacizumab injection significantly reduces central macular thickness 30 days after phacoemulsification in diabetic patients.

Anti-VEGF agents have become the preferred initial therapy for center-involving DME. Clinical trials report improved visual acuity and reduced macular thickness after intravitreal bevacizumab in DME.^{12–14} Preclinical and clinical data support its short-term ocular safety, with negligible systemic exposure at standard doses.¹⁵

Cataract surgery in diabetics produces a surge in intraocular VEGF and inflammatory mediators. Administering anti-VEGF before surgery aims to precondition the retina, preserve barrier function, and

blunt the postoperative inflammatory response. Khodabandeh et al, found that patients receiving preoperative bevacizumab had significantly lower central macular thickness one month after surgery compared with controls.¹¹ Other prospective studies have reported similar anatomical benefits.^{16–18}

In Pakistan, diabetes prevalence is rising rapidly, with diabetic retinopathy affecting roughly one-third of known diabetics and macular edema present in up to 12%.¹⁹ Access to laser and newer anti-VEGF agents is limited, making bevacizumab a practical option. Local reports describe meaningful reductions in central foveal thickness and improvements in visual acuity following bevacizumab injection.^{20–22}

Persistent hyperglycaemia activates pathways that increase VEGF expression in retinal glial and pigment epithelial cells.²³ Elevated VEGF disrupts occludin and claudin tight junctions, increasing endothelial permeability and allowing fluid to accumulate in the macula.²⁴ Cataract surgery adds an acute inflammatory stimulus, further elevating VEGF and cytokines and predisposing to macular edema.⁸

Bevacizumab binds VEGF-A and blocks its interaction with VEGF receptors, restoring barrier integrity and reducing leakage. Our results align with Khodabandeh et al., who observed a 26.3 µm lower thickness at one month with preoperative bevacizumab.¹¹ The slightly greater reduction in our cohort may reflect differences in baseline edema and surgical factors.

The role of prophylactic anti-VEGF remains under discussion. The Diabetic Retinopathy Clinical Research Network found no advantage for perioperative ranibizumab in eyes without baseline DME.²³ However, in eyes with pre-existing edema,

perioperative anti-VEGF decreased the risk of worsening and supported better visual outcomes.²⁴ Our inclusion of patients with baseline thickness >300 µm likely captured subclinical DME, explaining the observed benefit.

Safety is paramount for intraocular injections. We observed no cases of endophthalmitis, retinal detachment, or sustained pressure elevation. Large registries report low infection rates when strict aseptic technique is used.²¹ Systemic exposure after intravitreal bevacizumab is minimal at the 1.25 mg dose, and systemic adverse events are uncommon.²⁴ Long-term safety with repeated dosing requires further study.

Cost considerations favor bevacizumab in low-resource settings. It is substantially less expensive than ranibizumab or aflibercept, improving accessibility. In Pakistan, where out-of-pocket payments predominate, cost-effective prophylaxis can reduce the burden of postoperative visual loss.

Clinically, these findings suggest that preoperative bevacizumab should be considered for diabetic patients with baseline macular thickness >300 µm, poor glycemic control, or prior DME who are undergoing cataract surgery. Such an approach may reduce the incidence of postoperative macular edema and preserve vision, especially where postoperative monitoring is limited.

Limitations include a 30-day follow-up window and single-center design. Multicenter trials with longer follow-up would strengthen the evidence base. Future work should address optimal timing, dose, and agent selection. Head-to-head comparisons of bevacizumab, ranibizumab, and aflibercept in the preoperative setting are needed. Patient-reported outcomes and cost-effectiveness analyses specific to the Pakistani healthcare context would guide implementation.

CONCLUSION

Preoperative intravitreal bevacizumab significantly reduces postoperative central macular thickening after phacoemulsification in diabetic patients. The intervention appears safe over 30 days and offers a practical strategy to mitigate the risk of worsening diabetic macular edema in resource-constrained environments.

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Patient's Consent: Researchers followed the guidelines set forth in the Declaration of Helsinki.

Conflict of Interest: Authors declared no conflict of interest.

Ethical Approval: The study was approved by the Institutional review board/Ethical review board (19-23/GMC).

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Authors Designation and Contribution

Usman Rasheed; Senior Registrar: *Concepts, Design, Literature Search, Data Analysis, Manuscript Preparation, Manuscript Editing, Manuscript Review.*

Zeeshan Hameed; Senior Registrar: *Concepts, Design, Data Acquisition, Statistical Analysis, Manuscript Preparation, Manuscript Review.*

Ali Hassan Iqbal; Senior Registrar: *Literature Search, Data Acquisition, Data Analysis, Manuscript Editing, Manuscript Review.*

Aqsa Baloch; Postgraduate Resident: *Literature Search, Data Acquisition, Statistical Analysis, Manuscript Editing, Manuscript Review.*

Ayesha Ali; Postgraduate Resident: *Literature Search, Data Analysis, Manuscript Preparation, Manuscript Review.*

