

Research Article

Preventing Macular Edema with Preoperative Intravitreal Bevacizumab in Diabetic Retinopathy Patients Undergoing Phacoemulsification

Sidra Zafar Iqbal¹, Zafar Iqbal²

¹MD, John Hopkins Hospital, Baltimore, USA

²FRCS, Consultant Ophthalmologist, Dr. Ziauddin Hospital / Ex-Head of Department, Prince Abdul-Aziz Bin Mosaad Hospital, Arar, KSA

Corresponding Author: Zafar Iqbal, FRCS, Consultant Ophthalmologist, Dr. Ziauddin Hospital / Ex-Head of Department, Prince Abdulaziz Bin Mosaad Hospital, Arar, KSA

Email: syedzafariqbal123@gmail.com

Received: 12.01.26, Revised: 05.04.26, Accepted: 17.04.26

ABSTRACT

Background: Patients with diabetic retinopathy who have phacoemulsification may face a higher risk of postoperative macular edema that can greatly affect the visual results.

Objective: To measure the ability of preoperative intravitreal bevacizumab to prevent postoperative macular edema and improve visual outcomes in diabetic retinopathy patients attending phacoemulsification.

Methods: This prospective randomized controlled study was conducted at Prince Abdul-Aziz Bin Mosaad Hospital Arar, KSA from November 2025 to April 2025. 120 diabetic retinopathy patients with cataract were enrolled in the study and divided into two equal groups. Group A received preoperative intravitreal bevacizumab, and Group B underwent phacoemulsification alone.

Results: The reduction in central macular thickness of Group A was so evident that it was considered significant in comparison to Group B at both 1 and 3 months ($p < 0.001$). The rate of observing macular edema postoperatively was less in Group A (10% at 1 month) than in Group B (30%).

Conclusion: Patients with diabetic retinopathy undergoing phacoemulsification can benefit from preoperative intravitreal bevacizumab, which has been shown to be a safe and effective method of preventing postoperative macular edema and improving visual recovery.

Keywords: Diabetic Retinopathy, Macular Edema, Bevacizumab, Phacoemulsification, Anti-VEGF Therapy, Visual Acuity, OCT

INTRODUCTION

Among individuals of working age, diabetic retinopathy (DR) is always among the leading causes of loss of vision globally. In the same way, visual rehabilitation outcomes are difficult to achieve in cases of DR with cataract. In order to be more precise, phacoemulsification cataract surgery is regarded to be the most effective way of restoring vision. However, in diabetic patients, it is one of the biggest causes of the eyes failing to improve after surgery, which is due to the development of complications such as macular edema. Macular edema is essentially a thickening of the retina due to the build-up of fluid in the macula. Inflammatory and vascular changes that occur after the surgery trigger it and exacerbate it. The recent discovery is that with the presence of microvascular damage already and with a high degree of vascular permeability, diabetic eye is highly susceptible to post-operative retinal changes (1). The pathophysiology of this complication is largely due to the rise of vascular endothelial growth factor (VEGF) which, in addition to being a major determinant of vascular

leakage, also has a secondary effect of stimulating the development of edema (2). To conclude, the methods that control the function of VEGF have recently become a significant area of concern in improving the outcomes of surgery in such patients (3).

Recently the prophylactic interventions have been in the limelight particularly with the use of intravitreal pharmacotherapies in the prevention of postoperative macular edema. Anti-VEGF therapy such as bevacizumab is an eye-opener in terms of curbing the macular thickness and improving the eyesight of diabetic patients undergoing ocular surgery. Research has shown that the intravitreal bevacizumab prior to phacoemulsification can help to restrain inflammatory cascade and vascular leakage caused by surgical trauma (4). Moreover, an administration period, whether preoperative, intraoperative, or postoperative, is always a research issue, and preoperative administration appears to have some beneficial effects of stabilizing the retina prior to the surgical injury (5). It implies that the risks of postoperative

complications can be reduced and that the outcomes of the surgery can be more accurately predicted (6). The interaction of cataract induced visual impairment and underlying retinal pathology complicates phacoemulsification in diabetic patients, with complex clinical challenges to overcome. Diabetic macular edema (DME) at the time of surgery is a powerful predictor of adverse visual outcomes and preoperative testing and treatment is essential. The optical coherence tomography (OCT) has emerged as an essential instrument of checking the position of the macula and aiding in the treatment planning. Recent studies show that patients receiving intravitreal injection of bevacizumab prior to surgery have improved OCT outcomes, such as less central macular thickness and more retinal morphology intact following surgery (7). Moreover, a part of the role in reducing postoperative complications is played by the control of intraocular inflammation with adjunctive therapies, which, in a sense, reaffirms the importance of a multimodal approach to treatment (8). The comparative studies which have evaluated different intravitreal agents have provided rather a considerable number of significant points which can be utilized in determining the best possible treatment option. Anti-VEGF agents are the primary support of treatment, and other classes of pharmacological agents that address the inflammatory component have been considered. However, anti-VEGF therapy has invariably been shown to be the most appropriate method of averting vascular leakage and neovascular problems.

There have been clinical trials that suggest that prophylactic intravitreal injections may significantly reduce the development of postoperative complications such as hemorrhage and edema in diabetic patients undergoing vitreoretinal surgeries (9). Thus, the findings suggest the broader applicability of intravitreal therapies in cataract surgeries and other indications of diabetic eye treatment (10). The issue of whether an intravitreal injection is to be administered concomitantly with cataract surgery or in a separate procedure has been brought up and discussed in the light of integrative strategies. The injection done simultaneously with the surgery is convenient because it provides the therapy immediately, whereas the one done prior to the surgery is more effective in preparing the retina, which is unlikely to be impacted by the surgery, and the results of the surgery can be improved. Observational studies of patients indicate that the combined treatment significantly improves the visual acuity of patients and reduces the

macular thickness in comparison to surgery (11). Simultaneously, the presence of inflammation and increased intraocular pressure are two possible postoperative complications, and the necessity to be careful when choosing patients and conducting regular check-ups will become a necessity (12).

Surgery and medicine have evolved and altered the treatment of diabetic macular edema. Two novel treatments, microinvasive vitrectomy and combination therapies are under trial to determine whether they can yield better outcomes. It has already been proven in clinical trials that anti-VEGF therapy and surgery can be effective in various cases, which, in its turn, makes the necessity of individual treatment (13). Moreover, intravitreal corticosteroids are applied in managing inflammation and restoring vision to the patients, which can have side effects (14). Intravitreal therapy is continually evolving under the influence of innovations in drug delivery and increased effects. Due to its low cost and manufacturing capacity, Bevacizumab is usually the best choice, particularly in the poorer nations. Its use as a surgery prep has been demonstrated through research whereby it has resulted in reduced occurrence of complications during surgery and quicker recovery after surgery (15). The injection of Bevacizumab prior to operation also causes less bleeding during surgery and the surgeon can see better, thus making the surgery safer (16).

One of the primary determinants of the outcomes of treatment is the timing of anti-VEGF administration. To illustrate this, there are a few recent randomized clinical trials that investigated the optimal time of intravitreal drug administration and found that it might be more suitable to administer the injection prior to surgery to reduce the number of complications and lead to improved visual performance (17). At present, the treatment guidelines recommend that initial treatment with anti-VEGF and continuous follow-up are essential not only to prevent the further progression of the condition but also to guarantee its effective visual recovery (18). In addition to that, studies are being carried out on newer forms of anti-VEGF and their application together with other medications to achieve an even greater level of treatment efficacy and patient satisfaction (19). It is against this backdrop that the introduction of preoperative intravitreal bevacizumab can be regarded as one of the latest and most efficient ways of preventing macular edema following cataract surgery in diabetic patients with retinopathy. As it directly interacts with the disease mechanism, and can assist in reducing complications associated with surgery, such

approach can play a significant role in enhancing the visual performance, as well as, overall well-being of the concerned patients.

Objective: To assess whether preoperative intravitreal bevacizumab can effectively prevent postoperative macular edema and improve visual recovery in diabetic retinopathy patients who have phacoemulsification surgery.

MATERIALS AND METHODS

Study Design: A prospective randomized controlled study.

Study Setting: Prince Abdul-Aziz Bin Mosaad Hospital Arar, KSA.

Duration of Study: From November 2025 to April 2025.

Sample Size: 120 patients were incorporated into this study, which was calculated based on 95% confidence level, 5% margin of error, and the anticipated prevalence of postoperative macular edema in diabetic patients.

Sampling Technique: A non-probability consecutive sampling method was applied.

Inclusion Criteria: The patients who were aged between 40-75 years with diabetic retinopathy and cataract severe enough to need phacoemulsification were selected. The respondents were selected based on the presence of stable systemic diseases and a baseline OCT showing macular edema or at risk.

Exclusion Criteria: Exclusion criteria included patients who had prior intraocular surgery, severe glaucoma, active eye infection, vitreoretinal disease other than diabetic retinopathy or those who had an intravitreal injection within three months.

Methods: All the enrolled patients underwent full ophthalmic work-up during which the best corrected visual acuity, slit-lamp examination, fundus examination, and OCT to measure the central macular thickness were examined. A random selection of the patients was done into two groups Group A, which received preoperative intravitreal bevacizumab (1.25 mg/0.05 ml) 1 week prior to the phacoemulsification, and Group B, which received phacoemulsification operation only. All of them were done by skilled surgeons who used the same technique of phacoemulsification, and intraocular lens implantation. The patients were followed 1 week, 1 month and 3 months of operation. Central macular thickness change, postoperative macular edema and the best-corrected visual acuity were the key outcomes. The statistical tests were conducted in SPSS version 26 and the statistical significance was set at $p < 0.05$.

RESULTS

This study enrolled 120 patients (120 eyes) and divided them into two equal groups: Group A which received preoperative intravitreal bevacizumab + phacoemulsification and Group B which received phacoemulsification only.

Table 1: Baseline Characteristics of Study Participants

Variable	Group A (n=60)	Group B (n=60)	p-value
Mean Age (years)	57.9 ± 8.4	58.8 ± 8.9	0.62
Male (%)	33 (55%)	31 (51.7%)	0.71
Duration of Diabetes (years)	9.2 ± 3.5	9.5 ± 3.8	0.68
Baseline BCVA (logMAR)	0.78 ± 0.12	0.80 ± 0.11	0.55
Central Macular Thickness (µm)	312 ± 28	315 ± 30	0.49

After the operation, analysis revealed significant differences in the two groups. In Group A, a significant reduction in the central macular thickness was observed at 1-month follow-up,

unlike Group B. In Group A, the central macular thickness was reduced to an average of 276 + 22 µm and in Group B, it was elevated to 338 + 35 µm ($p < 0.001$).

Table 2: Postoperative Central Macular Thickness and Macular Edema Incidence

Outcome	Group A (n=60)	Group B (n=60)	p-value
CMT at 1 Month (µm)	276 ± 22	338 ± 35	<0.001
CMT at 3 Months (µm)	268 ± 20	330 ± 32	<0.001
Macular Edema (1 Month)	6 (10%)	18 (30%)	0.006
Macular Edema (3 Months)	5 (8.3%)	15 (25%)	0.01

The treatment group also performed better on vision results. Group A had a significantly higher

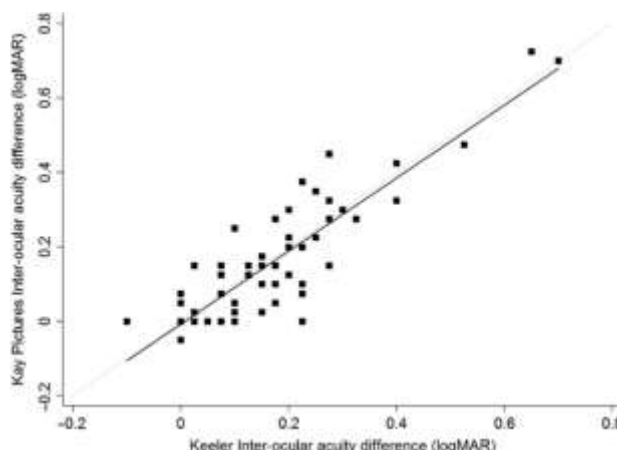
best-corrected visual acuity (BCVA) than Group B over the 3 months period of follow-up.

Table 3: Visual Acuity Outcomes

Time Point	Group A (logMAR)	Group B (logMAR)	p-value
Baseline	0.78 ± 0.12	0.80 ± 0.11	0.55
1 Month	0.40 ± 0.10	0.55 ± 0.12	<0.001
3 Months	0.28 ± 0.09	0.42 ± 0.11	<0.001

Generally, the graphical pattern indicates that there was a steady decrease in central macular thickness for Group A. In contrast, Group B

exhibited an elevation in the beginning, and then a small fall, so the level remained above the initial value.



DISCUSSION

The reduction in the central macular thickness (CMT) in the experimental group is consistent with the previous study that indicates the importance of the timing of anti-VEGF therapy (1). Preoperative injection stabilizes the retinal microenvironment leading to the minimal vascular leakage post-surgery (2). In the meantime, the patients that were not treated with bevacizumab demonstrated more macular thickness following the surgery, which indicates that phacoemulsification has the potential to exacerbate subclinical edema in diabetic eyes. It has been demonstrated in clinical trials that the preoperative or concomitant anti-VEGF therapy was beneficial in terms of OCT parameters and decreased edema progression (3). The benefits of preoperative bevacizumab have also been indirectly shown by vision outcomes. The striking difference in best-corrected visual acuity (BCVA) between Group A and Group B appears that superior anatomy results in superior functioning. Research supports this statement by demonstrating that a decrease in macular thickness is strongly associated with visual recovery of diabetic patients following phacoemulsification (4). Equally, immediate use of bevacizumab could prevent the long-term retinal swelling in the retina that can result in irreversible retinal damage, preserve photoreceptor cells, and even restore vision. In addition, the results of the study attract the attention to the necessity of perioperative care of diabetic patients. Surgery can cause inflammation and oxidative

stress which may worsen retinal diseases. One way to overcome these effects is by adopting intravitreal bevacizumab prophylaxis (5). In addition, pharmacological therapy, paired with the latest imaging technologies such as optical coherence tomography (OCT), enables continuous monitoring of the changes that take place post-surgery and timely intervention, resulting in improved patient care (6). A study of dexamethasone implants versus aflibercept injections indicates that both are effective in reducing the mucus around the eye, but their application is limited due to factors such as cost, availability, and side effects (7). On the other hand, bevacizumab is a good compromise in terms of efficacy and cost, and the most preferable option in less developed countries (8). The primary difference is that the postoperative macular edema rate was lower in the bevacizumab group. As a matter of fact, this demonstrates that providing the patient with treatment prior to the surgery not only contributes to the improved outcomes, but also reduces the necessity of additional treatments following the surgery.

Likewise, past randomized trials have reported that the administration of anti-VEGF therapy as a preventive measure results in significant reduction in the occurrence of complications (9). These results have significant clinical implications since they can result in a decrease in the amount of healthcare spending and can increase patient compliance by reducing the number of exposures that patients have to the therapy(10). In addition, it is important to

remember about very good tolerability of intravitreal bevacizumab. The present research demonstrated that the risk of safety was extremely low and that there were no significant ocular events such as endophthalmitis, increase in intravitreal pressure, or retinal detachment after intravitreal bevacizumab when administered under sterile conditions. Co-occurring with this, these findings are consistent with the body of knowledge in ophthalmic literature that indicates high safety margins of bevacizumab (11). Nonetheless, the most important thing is that patient selection practices must be safe and appropriate and that the careful adherence to the standardized protocol must be adhered to in order to contain risk (12).

Combination therapies and surgical interventions are increasingly becoming important in the management of diabetic eye disease. Actually, recent research indicates that a combination of anti-VEGF treatment and least invasive surgical interventions is a viable approach of attaining even greater outcomes (13). Also, the supportive treatment of corticosteroids has been taken into account in the inflammatory component of the macular edema, and there are still concerns about the safety of long-term use (14). In the future, it would be worthwhile to have studies aimed at determining the most effective mix of therapies and coming up with personalized therapies depending on the severity of the disease and other patient related variables. In addition, it is essential to determine the time when one should begin the treatment. Although the current research supports the use of the drug as a preoperative agent, there is also literature on the use of the agent as a perioperative or postoperative agent, with inconclusive results. According to the findings of the controlled studies, the intervention in an earlier stage is likely to be more beneficial in regulating the VEGF activity and decreasing complications (15). In addition to this, preoperative administration of bevacizumab also assists in the betterment of the surgery conditions due to reduced blood loss during the operation and enhanced visualization (16) which could lead to the safer and more precise operations.

In the recent past, the development of anti-VEGF drugs and modes of delivery has improved greatly to offer improved treatment outcomes. There is the development of agents which remain longer and the use of sustained-release preparations which will reduce the number of injections and improve patient compliance (17). Presently, the treatment regimens recommend prompt identification and

treatment of diabetic macular edema in spots to avoid vision loss (18). Besides that, new drugs and combined therapies are being tested in clinical studies to yield more effective results (19). Overall, the findings of this study are very much in favor of preoperative intravitreal bevacizumab as the most appropriate approach in the prevention of macular edema when performing phacoemulsification in patients with diabetic retinopathy. Looking at the vascular and inflammatory nature of the disease together, this approach is incredibly effective in enhancing surgical results and visual recovery, which is why it is a very valuable addition to the contemporary ophthalmic practice.

CONCLUSION

Preoperative intravitreal bevacizumab is an effective and safe intervention in preventing the macular edema post-surgery in the patients of diabetic retinopathy who undergo phacoemulsification. The findings show significant reduction of central macular thickness and improved visual performance in the patients undergoing bevacizumab visual therapy over the patients undergoing surgery alone. The technique reduces vascular permeability and inflammation, postoperative complications and visual recovery by acting on VEGF. Moreover, bevacizumab is a viable medical practice option due to its affordability and availability, especially in developing countries. Anti-VEGF therapy when given prior to the regular surgical procedure may result in better patient outcomes and less postoperative therapy. A bigger cohort and longer follow up period research is required to verify these findings, as well as to improve the treatment choices of diabetic patients requiring a cataract operation.

REFERENCES

1. Zhang R, Dong L, Yang Q, Liu Y, Li H, Zhou W, Wu H, Li Y, Li Y, Yu C, Wei W. (2022). Prophylactic interventions for preventing macular edema after cataract surgery in patients with diabetes: a Bayesian network meta-analysis of randomized controlled trials. *EClinicalMedicine*, 49.
2. Güven YZ, Işık MU, Ilgüy S, Yozgat Z. (2025). Phacoemulsification surgery in patients with diabetic macular edema: should intravitreal anti-VEGF therapy be performed before or simultaneously with surgery? *International Journal of Ophthalmology*, 18(4), 637.
3. Khalil HF, Hussein MO, Dagher MY. (2024). Results of intravitreal injection of bevacizumab before and with

- phacoemulsification in management of diabetic macular edema in cataractous patients. *Al-Azhar International Medical Journal*, 5(6), 34.
4. Hwang S, Hong EH, Kang MH, Shin YU. (2025). Early postoperative bevacizumab for preventing neovascular glaucoma in phacovitrectomy for proliferative diabetic retinopathy. *Scientific Reports*, 15(1), 1231.
 5. Furino C, Boscia F, Niro A, D'Addario M, Grassi MO, Saglimbene V, Reibaldi M, Alessio G. (2021). Diabetic macular edema and cataract surgery: phacoemulsification combined with dexamethasone intravitreal implant compared with standard phacoemulsification. *Retina*, 41(5), 1102–1109.
 6. Chan LK, Lin SS, Chan F, Ng DS. (2023). Optimizing treatment for diabetic macular edema during cataract surgery. *Frontiers in Endocrinology*, 14, 1106706.
 7. Mesen S, Suna B, Mesen A. (2025). Evaluation of optical coherence tomography parameters in diabetic macular edema patients who underwent phacoemulsification and intravitreal bevacizumab. *Retina Vitreus Journal*, 34(4).
 8. Ren Y, Du S, Zheng D, Shi Y, Pan L, Yan H. (2021). Intraoperative intravitreal triamcinolone acetate injection for prevention of postoperative inflammation and complications after phacoemulsification in patients with uveitic cataract. *BMC Ophthalmology*, 21(1), 245.
 9. Qu J, Chen X, Liu Q, Wang F, Li M, Zhou Q, Yao J, Li X. (2023). Prophylactic intravitreal injection of aflibercept for preventing postvitrectomy hemorrhage in proliferative diabetic retinopathy: A randomized controlled trial. *Frontiers in Public Health*, 10, 1067670.
 10. Bodla AA, Kazmi SM, Tariq N, Moazzam A, Aman MM. (2021). Effects of intra-vitreous injection of bevacizumab as an adjunct during phacoemulsification in diabetic maculopathy. *Pakistan Journal of Ophthalmology*, 37(1).
 11. Yen CY, Yen JC, Chen CC, Hu HY, Cheng FS, Tseng PC. (2022). Therapeutic effect of cataract surgery with simultaneous intravitreal injection of aflibercept on diabetic macular edema: An observational study. *Medicine*, 101(33), e30115.
 12. Gershoni A, Barayev E, Jbara D, Hadayer A, Axer-Siegel R, Dotan A, Gal-Or O, Tuuminen R, Ehrlich R. (2022). Postoperative complications of combined phacoemulsification and pars plana vitrectomy in diabetic retinopathy patients. *Frontiers in Medicine*, 9, 978346.
 13. Guo H, Li W, Nie Z, Zhang X, Jiao M, Bai S, Duan N, Li X, Hu B. (2023). Microinvasive pars plana vitrectomy combined with internal limiting membrane peeling versus anti-VEGF intravitreal injection for treatment-naïve diabetic macular edema (VVV-DME study): study protocol for a randomized controlled trial. *Trials*, 24(1), 685.
 14. Zaher Addeen S, Shaddoud I. (2022). Combined phacoemulsification surgery and intravitreal triamcinolone injection versus stand-alone surgery in patients with type 2 diabetes: a prospective randomized trial. *BMC Ophthalmology*, 22(1), 445.
 15. Furino C, Boscia F, Reibaldi M, Alessio G. (2021). Intravitreal therapy for diabetic macular edema: an update. *Journal of Ophthalmology*, 2021, 6654168.
 16. Ciftci F, Alikma MS, Gungel H. (2022). Preoperative effectiveness of bevacizumab in patients undergoing vitrectomy due to diabetic vitreous hemorrhage. *Retina Vitreus Journal*, 31(2).
 17. VO P, VN K, OM Y. (2025). A randomized prospective study on the timing of ranibizumab administration before vitrectomy in patients with severe diabetic retinopathy: assessing complications, visual outcomes, and retinal traction development. *Asian Journal of Research and Reports in Ophthalmology*, 8(1).
 18. Tatsumi T. (2023). Current treatments for diabetic macular edema. *International Journal of Molecular Sciences*, 24(11), 9591.
 19. Li H, Niu Y, Rong A, Bi Y, Xu W, Cui H. (2023). Effect of adjunctive intravitreal conbercept injection at the end of 25G vitrectomy on severe proliferative diabetic retinopathy: 6-month outcomes of a randomised controlled trial. *Ophthalmology and Therapy*, 12(2), 1173–1180.