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EVALUATION OF THE EFFECT OF SUPRA-CHOROIDAL TRIAMCINOLONE INJECTION ON REFRACTORY DIABETIC MACULAR EDEMA

Original Research

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ABSTRACT

Background: Diabetic macular edema (DME) is one of the most common causes of visual impairment among patients with diabetic retinopathy and remains a leading contributor to preventable blindness worldwide. Although anti-vascular endothelial growth factor (anti-VEGF) agents have revolutionized its management, a considerable proportion of patients fail to respond adequately to such therapies. Alternative treatment strategies, including targeted corticosteroid delivery through the suprachoroidal route, are gaining interest as potential options for refractory cases.

Objective: To evaluate the outcome of suprachoroidal triamcinolone injection on refractory diabetic macular edema in patients presenting at a tertiary care hospital in Lahore.

Methods: This descriptive study was carried out at Unit 1, Department of Ophthalmology, Services Hospital Lahore, from June to December 2024. A total of 80 patients aged 18–80 years with type 2 diabetes mellitus and refractory DME were enrolled through non-probability convenience sampling. Refractory DME was defined as central foveal thickness (CFT) >250 µm on optical coherence tomography (OCT) with no visual improvement despite six consecutive monthly anti-VEGF injections. Baseline assessment included demographic details, best-corrected visual acuity (BCVA) measured by the Snellen chart, intraocular pressure (IOP) measured by Goldmann applanation tonometry (AT 900, Haag-Streit, USA), and central macular thickness (CMT) measured by OCT. Patients received suprachoroidal triamcinolone injection using a custom-prepared needle. Follow-up evaluations were conducted at one and three months. Data were analyzed using SPSS version 23, with paired t-tests applied to compare baseline and follow-up outcomes. A p-value ≤0.05 was considered statistically significant.

Results: The mean age of patients was 55.26 ± 11.13 years, with an average diabetes duration of 11.27 ± 7.00 years. At baseline, the mean CMT was 650.52 ± 92.91 µm, which decreased to 451.41 ± 73.54 µm at one month and further to 274.51 ± 44.24 µm at three months ($p < 0.001$). Similarly, mean BCVA improved from 0.87 ± 0.071 logMAR at baseline to 0.67 ± 0.09 logMAR at one month and 0.52 ± 0.09 logMAR at three months ($p < 0.001$).

Conclusion: Suprachoroidal triamcinolone injection demonstrated significant improvement in both visual acuity and macular thickness, establishing it as an effective and safe therapeutic approach for refractory diabetic macular edema in tertiary care settings.

Keywords: Best Corrected Visual Acuity, Central Macular Thickness, Diabetic Macular Edema, Intraocular Pressure, Outcome Assessment, Steroids, Suprachoroidal Triamcinolone.

INTRODUCTION

Diabetic macular edema (DME) is recognized as the most common cause of central vision loss in individuals with diabetic retinopathy, posing a significant challenge to visual health worldwide (1,2). It is considered one of the most frequent ocular complications of diabetes, capable of leading to major visual impairment (3). Although it can occur at any stage of diabetic retinopathy, its risk increases with the progression of the disease (4). With the global diabetes burden projected to exceed 500 million people in the coming decades, diabetic retinopathy is anticipated to remain a major threat to human eyesight, affecting millions across diverse populations (5). Currently, diabetic retinopathy is the leading cause of acquired vision loss among middle-aged and economically active individuals, with around one-third of diabetic patients experiencing some degree of retinal involvement. According to the World Health Organization, 4.8% of blindness cases worldwide are attributable to diabetic retinopathy, and prevalence studies report its occurrence in approximately 25.2% of individuals with type 2 diabetes (6). In Pakistan, the burden of diabetes mellitus is steadily rising, with recent estimates placing prevalence between 7.6% and 11%, underscoring the urgent need for effective management strategies (7).

In recent years, therapeutic interest has expanded toward localized delivery of corticosteroids, particularly through innovative techniques targeting specific ocular compartments (8). The suprachoroidal space has emerged as a promising route for drug administration, with triamcinolone acetonide—an established synthetic corticosteroid with potent anti-inflammatory effects—being studied for its efficacy in reducing macular edema and improving visual outcomes (9). Triamcinolone acetonide has a long history of use in ocular and systemic inflammatory conditions, but its suprachoroidal delivery offers the potential advantage of targeted drug deposition, higher local bioavailability, and reduced systemic exposure. Given the limitations of current therapies for refractory DME and the ongoing need for novel, effective, and safe treatment approaches, suprachoroidal injection of triamcinolone acetonide represents a potential therapeutic innovation. Exploring its efficacy in patients who do not respond to standard interventions could provide an important addition to the management of this vision-threatening condition. Clinical research evaluating new interventions frequently relies on standardized measures such as sensitivity, specificity, and predictive values to establish diagnostic and therapeutic validity (10). The objective of this study was therefore to evaluate the outcomes of suprachoroidal triamcinolone acetonide injection in patients with refractory diabetic macular edema presenting at a tertiary care hospital in Lahore.

METHODS

This descriptive study was conducted at Unit 1, Department of Ophthalmology, Services Hospital, Lahore, over a six-month period from June to December 2024 following the approval of the study synopsis by the institutional ethical review committee. Written informed consent was obtained from all participants prior to enrollment, and confidentiality was ensured throughout the study process. The study included patients aged 18 to 80 years of both genders with type 2 diabetes mellitus who presented with refractory diabetic macular edema (DME), defined as central foveal thickness (CFT) greater than 250 µm on optical coherence tomography (OCT) with no visual improvement despite at least six consecutive monthly intravitreal anti-VEGF injections (4). Additional inclusion criteria comprised centrally involving DME with CFT greater than 300 µm confirmed by OCT, the presence of posterior vitreous detachment without anteroposterior vitreomacular traction, and no ocular treatment for DME in the preceding three months. Patients were excluded if they had pre-existing retinal pathology other than diabetic retinopathy, ischemic macular edema, glaucoma with intraocular pressure (IOP) ≥21 mmHg, or were on systemic medications known to influence macular thickness. A total of 80 patients were enrolled using non-probability convenience sampling. Sample size was determined through the WHO sample size calculator, with a 95% confidence level, margin of error 0.06, and mean best-corrected visual acuity (BCVA) of 0.45±0.27 at three months post-injection (1). Baseline demographic and clinical information including age, gender, duration of diabetes, body mass index (BMI), smoking history, IOP, BCVA, and CFT was documented on a pre-designed proforma. BCVA was measured using a standard Snellen chart and converted into logMAR values for analysis. IOP was recorded using Goldmann applanation tonometry (AT 900, Haag-Streit Inc., USA), while macular thickness was assessed through OCT.

The suprachoroidal triamcinolone injection was administered using a custom-designed needle preparation. A sterile 27-gauge insulin syringe was modified by attaching a silicon tube guard derived from a 22-gauge intravenous cannula (Rays Hemoflon, Italy) and trimmed

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to expose precisely 1 mm of the needle tip, as measured by a sterile caliper. Following paracentesis, 0.1 ml of triamcinolone acetonide suspension was aspirated, and the injection was delivered into the suprachoroidal space 3.5 mm posterior to the limbus in the inferotemporal quadrant. All procedures were performed under sterile conditions. Postoperatively, patients were prescribed topical fourth-generation fluoroquinolone eye drops (Moxifloxacin 0.5%, Vigamox, Alcon Labs, USA) four times daily for one week. Follow-up evaluations were scheduled at one and three months, where BCVA, CFT, and IOP were reassessed using the same methods. Data were entered and analyzed using SPSS version 23. Quantitative variables including age, BMI, duration of diabetes, BCVA, IOP, and CFT were expressed as mean±standard deviation (SD), while categorical variables such as gender and smoking history were presented as frequencies and percentages. Paired sample t-tests were applied to compare baseline, one-month, and three-month values of IOP, BCVA, and CFT. A p-value ≤0.05 was considered statistically significant.

RESULTS

The study included 80 patients with a mean age of 55.26 ± 11.13 years and an average duration of diabetes mellitus of 11.27 ± 7.00 years. Of these, 42 (52.5%) were male and 38 (47.5%) were female. Smoking was reported in 26 (32.5%) participants, while 13 (16.3%) had a positive family history of diabetes. Occupation-wise, 25 (31.3%) were homemakers, 19 (23.8%) were office workers, 15 (18.8%) were computer or IT professionals, 8 (10%) were business owners or shopkeepers, 8 (10%) were retired, and 5 (6.3%) were drivers. The mean daily screen time was 8.77 ± 4.06 hours, and the average duration of ocular symptoms was 1.34 ± 0.82 years. At baseline, the mean central macular thickness (CMT) was 650.52 ± 92.91 µm, which significantly decreased to 451.41 ± 73.54 µm at one month and further reduced to 274.51 ± 44.24 µm at the third month ($p < 0.001$). Correspondingly, the mean best-corrected visual acuity (BCVA) improved from 0.877 ± 0.071 logMAR at baseline to 0.67 ± 0.09 logMAR at one month and 0.52 ± 0.09 logMAR at the third month ($p < 0.001$). Further subgroup analysis at the third month showed that patients aged ≤50 years had a mean CMT of 272.51 ± 49.41 µm compared to 275.64 ± 49.41 µm in patients aged >50 years ($p = 0.763$). Male patients demonstrated a mean CMT of 269.59 ± 42.48 µm, while female patients had 279.94 ± 46.5 µm ($p = 0.299$). In those with diabetes duration ≤12 years, mean CMT was 272.02 ± 44.56 µm compared to 278.67 ± 44.12 µm in those with duration >12 years ($p = 0.519$). Smokers and non-smokers had mean CMT values of 277.19 ± 46.31 µm and 273.22 ± 43.59 µm respectively ($p = 0.709$). A significant reduction was observed in patients with a positive family history, who demonstrated a mean CMT of 255.0 ± 30.82 µm compared to 278.3 ± 45.61 µm in those without family history ($p = 0.032$). Similarly, at the third month, the mean BCVA in patients aged ≤50 years was 0.51 ± 0.08 logMAR compared to 0.53 ± 0.10 logMAR in those aged >50 years ($p = 0.508$). Male and female patients showed almost identical BCVA values of 0.52 ± 0.09 logMAR and 0.51 ± 0.10 logMAR respectively ($p = 0.99$). Duration of diabetes ≤12 years yielded a BCVA of 0.52 ± 0.09 logMAR compared to 0.53 ± 0.11 logMAR for those with duration >12 years ($p = 0.479$). No significant differences in BCVA were observed between smokers and non-smokers or between patients with and without a family history of diabetes ($p > 0.05$).

Table 1: Descriptive Statistics of Demographic and Clinical Parameters of The Patients

		Frequency	Percent
Age (Years)		55.26 ± 11.13	
Gender	Male	42	52.5
	Female	38	47.5
Smoking	Present	26	32.5
	Absent	54	67.5
Family History	Present	13	16.3
	Absent	67	83.8
Occupation	Business/Shopkeeper	8	10.0
	Job	19	23.8
	Housewife	25	31.3
	Computer operator/IT job	15	18.8
	Retired	8	10.0
	Driver	5	6.3
Duration of DM		11.27 ± 7.00	

	Frequency	Percent
Duration of ocular symptoms	1.34 ± 0.82	
Screen Time	8.77 ± 4.06	
CMT at baseline	650.52 ± 92.91	
CMT at one month	451.41 ± 73.54	
CMT at 3rd month	274.51 ± 44.24	
BCVA at baseline	0.877 ± 0.071	
BCVA at one month	0.67 ± 0.09	
BCVA at 3rd month	0.52 ± 0.09	

Table 2: Pre and Post Comparison of CMT And BCVA Values of The Patients (N = 80)

	At baseline	At 3rd month	p-value
CMT	650.52 ± 92.91	274.51 ± 44.24	<0.001
BCVA	0.87 ± 0.071	0.52 ± 0.09	<0.001

Table 3: Comparison of CMT And BCVA Values At 3rd Month in Different Groups of Effect Modifiers (n = 80)

		n	CMT	p-value	BCVA	p-value
Age (Years)	≤50	29	272.51 ± 49.41	0.763	0.51 ± 0.08	0.508
	>50	51	275.64 ± 49.41		0.53 ± 0.10	
Gender	Male	42	269.59 ± 42.48	0.299	0.52 ± 0.09	0.99
	Female	38	279.94 ± 46.5		0.51 ± 0.10	
Duration of diabetes	≤12	50	272.02 ± 44.56	0.519	0.52 ± 0.09	0.479
	>12	30	278.67 ± 44.12		0.53 ± 0.11	
Smoking	Present	26	277.19 ± 46.31	0.709	0.52 ± 0.09	0.884
	Absent	54	273.22 ± 43.59		0.52 ± 0.10	
Family History	Present	13	255.0 ± 30.82	0.032*	0.53 ± 0.11	0.880
	Absent	67	278.3 ± 45.61		0.52 ± 0.09	

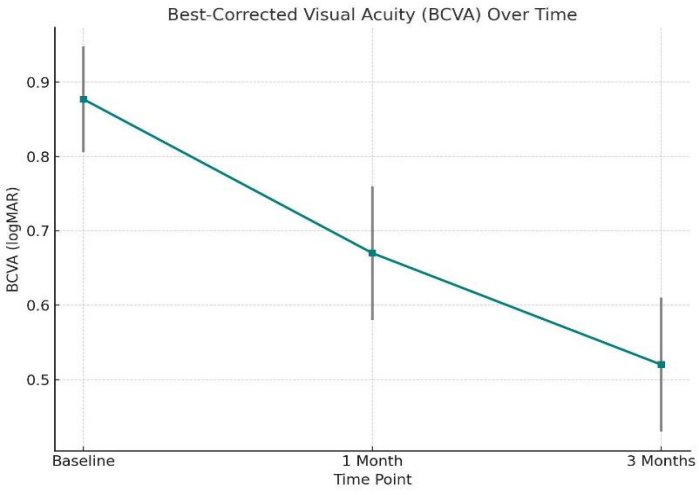

Figure 2 Best-Corrected Visual Acuity (BCVA) Over Time

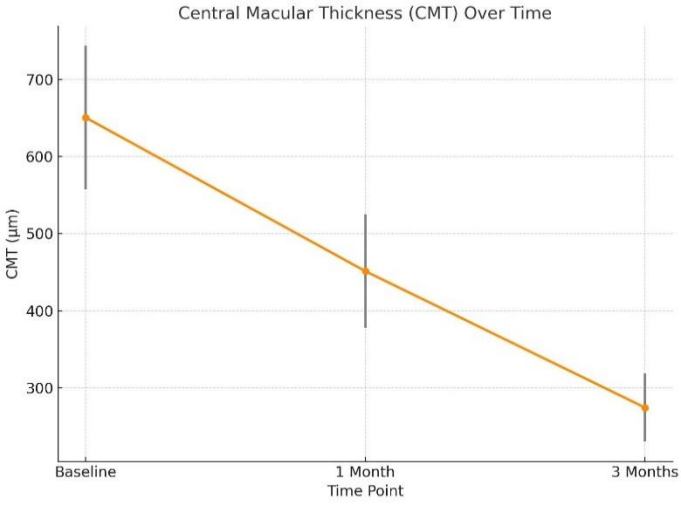

Figure 2 Central Macular Thickness (CMT) Over Time

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DISCUSSION

The present study demonstrated a significant reduction in central macular thickness (CMT) from 650.52 ± 92.91 µm at baseline to 274.51 ± 44.24 µm after three months of treatment with suprachoroidal triamcinolone injection. A corresponding improvement in best-corrected visual acuity (BCVA) was observed, with values improving from 0.87 ± 0.071 to 0.52 ± 0.09 logMAR within the same period ($p < 0.001$). These findings highlight the therapeutic potential of suprachoroidal corticosteroid delivery in patients with refractory diabetic macular edema (DME). Existing literature supports the current results, with multiple studies reporting similar improvements in both macular thickness and visual acuity following suprachoroidal administration of triamcinolone. One study documented a reduction in CMT from over 550 µm to nearly 313 µm, accompanied by a notable improvement in visual acuity, with statistical significance ($p < 0.001$) (11). Another study demonstrated a reduction in mean CMT from 299.76 ± 13.72 µm to 250.49 ± 17.82 µm after three months of therapy, reinforcing the efficacy of this treatment modality (12). Further studies have consistently shown sustained reductions in CMT to approximately 300 µm and improvements in BCVA within one to three months of injection, aligning closely with the outcomes of the present investigation (13,14). Importantly, some reports also emphasized stability of intraocular pressure (IOP) over time, indicating a favorable safety profile when suprachoroidal delivery is used compared with intravitreal routes (15,16). The implications of these findings are clinically significant. Refractory DME remains a major therapeutic challenge, as many patients fail to respond adequately to anti-VEGF agents despite prolonged treatment. The demonstrated benefits of suprachoroidal triamcinolone suggest it could serve as a viable alternative or adjunctive therapy for patients not achieving sufficient outcomes with standard interventions. By targeting the suprachoroidal space, the drug achieves higher local bioavailability at the site of pathology, with potentially fewer systemic and anterior segment complications compared to intravitreal corticosteroid delivery (17,18).

Strengths of this study include its focused evaluation of refractory DME, a group often underrepresented in clinical research, and the use of standardized OCT and BCVA measurements that allow for objective assessment of outcomes. The relatively homogenous patient group and clearly defined inclusion and exclusion criteria enhanced internal validity. Moreover, follow-up at one and three months enabled monitoring of both short- and medium-term effects of therapy. Nonetheless, limitations must be acknowledged. The study lacked a control group, which limits the ability to directly compare outcomes with anti-VEGF monotherapy or other interventions. The short follow-up period of three months restricts conclusions about long-term efficacy, recurrence rates, and delayed adverse effects such as cataract formation or steroid-induced glaucoma. Furthermore, while reductions in CMT and improvements in BCVA were reported, detailed safety parameters such as IOP changes and other ocular complications were not comprehensively analyzed, despite their clinical relevance for steroid-based therapy. The sample size, though adequate for initial analysis, may not fully represent the broader diabetic population with varying disease severities. Future studies should incorporate randomized controlled designs with larger cohorts, extended follow-up, and inclusion of safety endpoints to better establish the long-term role of suprachoroidal triamcinolone. Comparative trials against established anti-VEGF regimens and combination strategies may further clarify its place in treatment algorithms (19,20). Additionally, cost-effectiveness analyses and patient-reported outcomes could enhance understanding of the overall value of this therapy in real-world clinical practice. In summary, the findings of this study reinforce the growing evidence that suprachoroidal triamcinolone is an effective and promising therapeutic option for refractory DME. While short-term outcomes are encouraging, further robust clinical research is necessary to establish its long-term efficacy, safety, and optimal role within the current management paradigm of diabetic macular edema.

CONCLUSION

This study concluded that suprachoroidal triamcinolone injection proved to be an effective and safe therapeutic option for patients with refractory diabetic macular edema who had not responded to conventional interventions. By demonstrating meaningful improvements in visual outcomes and retinal health, the findings highlight the potential of this approach as a valuable addition to the existing treatment strategies for diabetic eye disease. The results emphasize the importance of exploring alternative targeted therapies to address unmet clinical needs and improve quality of life for affected patients.

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AUTHOR CONTRIBUTION

Author	Contribution
Muhammad Fakhar Tanveer*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Khawaja Mohsin Ihsan	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published

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