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Suprachoroidal Versus Intravitreal Injection of Triamcinolone Acetonide As Primary Treatment For Diabetic Macular Edema

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Abstract

Objective: This study aims to evaluate and compare the effects of suprachoroidal and intravitreal triamcinolone administration, as a primary treatment, on best corrected visual acuity (BCVA), central macular thickness (CMT), and intraocular pressure (IOP) in patients with diabetic macular edema (DME).
Methods: A quasi-experimental study was conducted from November 2022 to April 2023. 64 eyes were enrolled with Inclusion criteria comprising patients with diabetic macular edema (DME) (central involving) with BCVA < 6/9, CMT > 300 µm on optical coherence tomography (OCT), and no prior DME treatment. Patients were divided into suprachoroidal triamcinolone (SCTA) (Group I) and intravitreal triamcinolone (IVTA) (Group II) groups. Follow-up occurred at 1 week, 1 month, and 3 months post-injection. BCVA, CMT, and IOP were recorded. Data were analyzed using SPSS with a significance threshold of $p < 0.05$.
Results: Both treatment groups exhibited improved BCVA and reduced CMT. Suprachoroidal delivery demonstrated more substantial visual acuity improvements compared to the intravitreal group. Reduction in IOP was observed in the suprachoroidal group at 1stweek post-treatment ($p<0.001$), while the intravitreal group experienced increased IOP at later follow-ups ($p<0.001$).
Conclusion: This study illuminates the efficacy of both suprachoroidal and intravitreal triamcinolone administration as the primary treatment for DME. While both modalities displayed promising outcomes, suprachoroidal delivery exhibited more substantial visual acuity improvements with fewer side effects and promising alternatives for DME treatment.
Keywords: Macular Edema, Intravitreal, Triamcinolone Acetonide, Suprachoroidal, Visual Acuity, Intraocular Pressure.

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1. Introduction

Diabetic macular edema (DME) remains a significant and sight-threatening complication of diabetes mellitus, posing a substantial global public health concern. (1) DME is described as retinal thickening by abnormal accumulation of fluid at the macula. (2) The prevalence of vision impairment in patients with diabetic retinopathy (DR) is a critical concern, particularly considering its status as a primary contributor to vision loss among working-age adults on a global scale. (3) The public health burden of DR requires a search for assuring therapeutic approaches and advancement of current standards of DR care. (4) The management of DME is growing better with increased research, with the introduction of various treatment options aimed at reducing macular edema and improving visual outcomes. These include laser photocoagulation (5), VEGF agents (6), and intravitreal corticosteroids. (7)
Triamcinolone, a potent corticosteroid, has demonstrated efficacy in reducing macular edema by modulating the inflammatory response within the retina and choroid. Intravitreal triamcinolone acetonide injection has been studied extensively and has shown positive outcomes in terms of visual acuity improvement and central macular thickness reduction.[7] More recently, suprachoroidal triamcinolone delivery has emerged as a potentially innovative approach for DME treatment. The suprachoroidal space offers a unique anatomical advantage, offering localized drug delivery to the posterior region of the eye while minimizing potential complications associated with intravitreal injections. (8,9)
Numerous studies have underscored the efficacy of various treatment approaches for managing diabetic macular edema (DME), shedding light on potential strategies to enhance both anatomical and functional outcomes. Ateeq et al., observed that by using suprachoroidal triamcinolone significant variations were observed in CMT and BCVA during both follow-up assessments in comparison to the initial measurements ($p<0.05$). The injection of

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suprachoroidal triamcinolone acetonide had a notable and positive impact in reducing diabetic macular edema. [10] In another study efficacy of SCTA in treating resistant DME was evaluated. Mean CMT improved from 635±200 um to 302 ±66.9 um ($p<0.00001$) while BCVA on ETDRS improved to 0.45 from 0.8 ($p<0.05$). In conclusion, it was determined that suprachoroidal triamcinolone acetonide (SCTA) is well-tolerated and has the potential to enhance the functional and structural outcomes of patients with treatment-resistant DME. [11]

Intravitreal dexamethasone implants have been explored as a reliable treatment regimen for various profiles of DME patients, including those who are pseudophakic, poor-adherents, or possess cardiovascular complications. [12] Additionally, Steeples et al. found that preservative-free triamcinolone offers promise for uveitis-related macular edema, yielding central retinal thickness reduction and visual acuity improvement, albeit with the potential need for repeat injections. [13]
Moreover, the effect of IVTA injection was investigated in vitrectomy for proliferative diabetic retinopathy, suggesting its potential efficacy in reducing diabetic macular edema at the early post-surgery stage. [14]
The primary objective of this research is to evaluate and compare the effects of suprachoroidal and intravitreal triamcinolone administration as the primary treatment for BCVA and CMT in patients with DME. Secondary objectives include assessing changes in intraocular pressure and providing insights into the feasibility and acceptability of these treatment modalities. This research paper aims to contribute to the growing body of knowledge regarding the efficacy of suprachoroidal and intravitreal triamcinolone administration in treating DME. By evaluating the effects of these interventions, this study seeks to provide valuable insights that can guide clinical decision-making and enhance patient care.

2. Materials & Methods

A quasi-experimental study was conducted at the –removed for blind review---from November 2022 to April 2023. Ethical committee approval was given. A total of 64 eyes of 64 patients were included. Patients were selected through consecutive sampling. The sample size was calculated as follows by considering the following variables:

Variable	Value
Mean 1	322.89
Mean 2	270.1
Variance	5490.817
Confidence level	0.95
Power	0.8
Tails	2

Sample size (per group): 32
Total sample size: 64 patients.
Known diabetic patients with BCVA less than 6/9 and CMT greater than 300 µm on OCT, who had not received prior DME treatment, were included. Patients who had a history of previous treatment for DME, are known cases of glaucoma, had macular oedema other than DME, and exhibited macular ischemia were excluded.
A detailed eye examination was performed on all patients. This included BCVA, OCT macula, and intraocular pressure (IOP).
Participants were divided into two groups: Group 1 received 4mg/0.1 mL suprachoroidal triamcinolone and Group II received 4mg/0.1 mL intravitreal triamcinolone.
Follow-up visits occurred at 1 week, 1 month, and 3 months post-injection. IOP was monitored during the first visit, while subsequent visits assessed BCVA, CMT, and IOP. Informed consent was obtained from participants.
The procedure was conducted under sterile conditions in a minor operating theatre. The injection site was either superotemporal or inferotemporal, located at 3.5 mm and 4 mm from the limbus in pseudophakic and phakic patients, respectively. Intravitreal triamcinolone was administered using a 30-gauge needle, while suprachoroidal injection utilized a custom-designed 30-gauge needle having a sterilized plastic sleeve, exposing approximately 1mm of the needle to avoid farther penetration into the vitreous cavity.15 Standard protocols of intraocular procedures were followed. Following injection, the needle was withdrawn, and pressure was applied using a cotton-tipped applicator at the injection site to prevent vitreous reflux.

Data was analyzed via SPSS version 26. The mean and standard deviation were calculated for quantitative variables like age, CMT (um), and IOP whereas qualitative variables like gender, and visual activity scores were calculated as frequency and percentages and compared. The chi-square test was used to determine the significance of the effect of treatment type on qualitative variables. A p-value less than 0.05 was considered significant.

3. Results

The mean age of the patients enrolled Group I was 36.18 ± 10.79 years ($p<0.001$) and in Group II was 32.5 ± 9.45 years ($p<0.001$). The visual acuity of the patients in each group was noted both before and after treatment as shown in Table I. It can be seen that visual acuity was improved in both treatment groups; however, in the SCTA group BCVA of 6/12 or better was observed in 53.1 % of patients post-treatment while in IVTA it was 46.8 %. This is further checked via Chi-square testing, which shows that the difference between pre-treatment and post-treatment visual scores about the type of treatment i.e., Suprachoroidal and Intravitreal was statistically significant i.e., $p<0.001$.

Moreover, the mean IOP was observed pre-treatment, 1 week, 1 month, and 3 months after treatment in both groups as shown in Table-2 It can be observed that the mean intraocular pressure was reduced from pre-treatment to 1 week after obtaining Suprachoroidal triamcinolone and then stayed the same in 1st or 3rd months after treatment. However, in the case of intravitreal triamcinolone, the mean IOP was reduced at 1st week but again increased at 1st and 3rd months of treatment.

Table-1 Comparison of visual acuity (VA) scores noted before and after treatment in both groups.

Visual Acuity (VA)					
Case Type		Pre-treatment Visual Acuity		Post-treatment Visual Acuity	
	Visual Acuity Score	No of eyes	Per cent	No of eyes	Per cent
Group I (SCTA)	6/12 or better	1	3.1	17	53.1
	≥6/60 to 6/18	24	75	15	46.8
	CF	7	21.8	0	0
	Total	32	100	32	100
Group II (IVTA)	6/12 or better	5	15.6	15	46.8
	≥6/60 to 6/18	23	71.8	15	46.8
	CF	4	12.5	2	6.25
	Total	32	100	32	100.0

Finally, CMT (um) was also observed in both groups before and after treatment. It can be seen from Table 3 that the mean CMT was reduced in both Groups I and II and the mean differences were statistically significant.

Table-2 Mean of Intraocular pressure (IOP) pretreatment, 1 week, 1 month and 3 months after the treatment in Group I and II

Case Type		N	Mean	Std. Deviation	p-value
Group I (SCTA)	Pre-treatment Intraocular Pressure (IOP)	32	14.6563	3.32740	<0.001
	IOP at 1st week	32	14.5938	2.82682	<0.001
	IOP at 1st month	32	14.3750	2.79111	<0.001
	IOP at 3rd month	32	14.3750	3.77385	<0.001
Group II (IVTA)	Pre-treatment Intraocular Pressure (IOP)	32	13.6250	2.39287	<0.001
	IOP at 1st week	32	13.4688	2.81682	<0.001
	IOP at 1st month	32	14.5313	3.51021	<0.001
	IOP at 3rd month	32	14.6563	3.41353	<0.001

Table-3 Mean CMT (um) of patients before and after treatment.

One-Sample Statistics					
Case Type		N	Mean	Std. Deviation	p-value
Group I (SCTA)	Pre-treatment CMT (um)	32	531.0938	174.46940	<0.001
	Post-treatment CMT (um)	32	297.2188	80.23744	<0.001
Group II (IVTA)	Pre-treatment CMT (um)	32	402.1875	103.85487	<0.001
	Post-treatment CMT (um)	32	265.9063	67.26566	<0.001

4. Discussion

In our study improvement in visual acuity was more pronounced in the suprachoroidal triamcinolone (SCTA) group compared to the intravitreal triamcinolone (IVTA) group. The 6/12 or better visual acuity score in the SCTA group, from 3.1% at pre-treatment to 53.1% post-treatment. On the other hand, in cases of the IVTA group, improvement of visual acuity from 15.6% to 46.8% from pre-treatment to post-treatment respectively. Contrary to this Tabl et al reported mean gain in BCVA as 1.00 in both groups. In the SCTA group, BCVA improved to 0.8 and in the IVTA group, it improved to 0.9 on the 3rd month follow-up. [15] Similar to our study Steven Yeh et al. reported 15 or more letter gain in BCVA in 47% of patients receiving SCTA. [16]

In our study, we have observed a significant reduction in central macular thickness (CMT) in both groups after treatment. In the SCTA group, CMT decreased from 531.09 ± 174.46 to 297.21 ± 80.23 ($p<0.001$) whereas in the IVTA group, it decreased from 402.187 ± 103.85 to 265.90 ± 67.26 ($p<0.001$). This reduction indicates triamcinolone's efficacy in reducing macular edema,

which can significantly impact visual acuity. Similarly, Steven Yeh et al. observed that the reduction in CST from baseline was substantially different between the two groups, measuring 153 μm in the SCTA group versus 18 μm in the control group ($P < 0.001$). These findings demonstrate that patients in the SCTA group experienced a clinically significant enhancement in their vision compared to those who underwent the placebo procedure. [17] Zakaria et al. reported that after 1 month, the most substantial decrease in CMT was observed, with values of 147.33 ± 110.97 μm, 160.80 ± 98.25 μm, and 65.64 ± 46.19 μm in groups I (IVTA), II (SCTA), and III (Low dose SCTA), respectively. This reduction was associated with the most significant improvement in BCVA, with changes of 0.09 ± 0.09, 0.19 ± 0.10, and 0.10 ± 0.09 log MAR lines in groups I, II, and III, respectively. [(17)]

Moreover, in our study, there was a reduction in mean IOP in the SCTA group, which decreased from 14.656 ± 3.32 at pre-treatment to 14.37 ± 3.77 ($p<0.001$) after 3 months whereas in the IVTA group, it was increased from 13.62 ± 2.39 to 14.656 ± 3.41 ($p<0.001$) at 3 months. The observed reduction in IOP in the SCTA group is noteworthy, as increased IOP is a potential side effect of corticosteroid treatment. Similar results were reported by Tabl et al. which stated that after 3rd month, the IVTA group exhibited a high reading of IOP (18mmHg) as compared to the SCTA group (14mmHg) ($P=0.028$). [(15)]

One of the limitations of our study was the small sample size, a larger sample could provide more statistical power and general findings. Also, the follow-up period of 3 months might not capture the long-term effects and complications of the treatments. Longer follow-up periods could provide better insights.

5. Conclusion

This study illuminates the efficacy of both suprachoroidal and intravitreal triamcinolone administration as the primary treatment for diabetic macular edema. While both modalities displayed promising outcomes, suprachoroidal delivery exhibited more substantial visual acuity improvements with fewer side effects and promising alternatives for DME treatment.

CONFLICTS OF INTEREST- None

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Contributions:

F.S.K, A.A - Conception of study
F.S.K, T.N, N.O, M.A - Experimentation/Study Conduction
F.S.K, T.N - Analysis/Interpretation/Discussion
F.S.K - Manuscript Writing
F.S.K, A.A, R.I.U.H - Critical Review
F.S.K, R.I.U.H, N.O, M.A - Facilitation and Material analysis

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