Journal of Medicine in Scientific Research

Volume 4 | Issue 1 | Article 8

Subject Area: Ophthalmology

Peribulbar injection of triamcinolone acetonide as an outpatient clinic procedure in the management of mild to moderate macular edema

Mohammed S. Ahmed
Sohag Teaching Hospital, dr.m.shikhoun@gmail.com

Recommended Citation

Ahmed, Mohammed S. (2021) "Peribulbar injection of triamcinolone acetonide as an outpatient clinic procedure in the management of mild to moderate macular edema," *Journal of Medicine in Scientific Research*: Vol. 4: Iss. 1, Article 8.
DOI: https://doi.org/10.4103/JMISR.JMISR_107_20

Peribulbar injection of triamcinolone acetonide as an outpatient clinic procedure in the management of mild to moderate macular edema

Mohammed S. Ahmed

Department of Ophthalmology, Sohag Teaching Hospital, Sohag, Egypt

Abstract

Background

Diabetic retinopathy is a microvascular complication of diabetes mellitus and is the most common and most blinding ophthalmic complication. Diabetic macular edema (DME) is an essential manifestation of diabetic retinopathy that occurs across all its severity levels. Several intraocular treatment modalities for diabetic eye disease exist, including per-bulbar steroid injections. This study was conducted aiming to study the clinical effect and central macular thickness decrease following an outpatient clinic simple procedure of peribulbar injection of prepared triamcinolone acetonide (TAA) as a single procedure.

Patients and methods

This study was performed on 100 eligible eyes in 70 consecutive patients. The study involved three times peribulbar injections of prepared TAA separated by 3-week interval with repeated follow-up of patients.

Results

The study revealed that repeated peribulbar injections of TAA resulted in significant visual acuity improvement and significant reduction in the central macular thickness in optical coherence tomography measurement. However, this was associated with a transient increase in intraocular pressure and lower lid edema (swelling). Our results confirm the usefulness of repeated peribulbar injections of TAA in mild to moderate DME management.

Conclusion

Peribulbar TAA injections should be regarded as a treatment for DME. Multicenter randomized trials must be performed comparing this therapy with other available and well-known modality treatments, and more extended follow-up periods are needed in future studies.

Keywords: Macular edema, peribulbar injection, triamcinolone acetonide

Introduction

Diabetic retinopathy (DR) is a microvascular complication of diabetes mellitus [1]. It is the most common and possibly the most blinding ophthalmic complication of diabetes [2]. DR is a burgeoning problem globally, currently affecting almost 100 million people worldwide and is set to become an ever-increasing health burden [3].

A healthy relationship was found between chronic hyperglycemia and the development and progression of DR [4]. DR falls into two broad categories: the earlier stage of nonproliferative diabetic retinopathy (NPDR) and the advanced stage of proliferative diabetic retinopathy (PDR) [5].

Diabetic macular edema (DME) is an essential manifestation of DR occurring in all DR severity stages of both NPDR and PDR and is the most common cause of vision loss in patients with DR.

Access this article online	
Quick Response Code:	**Website:** www.jmsr.eg.net
	DOI: 10.4103/JMISR.JMISR_107_20

Correspondence to: Mohammed S. Ahmed, MD, Department of Ophthalmology, Sohag Teaching Hospital, Sohag, Egypt. Tel: +20 100 717 0600; E-mail: dr.m.shikhoun@gmail.com

Submitted: 06-Oct-2020 **Revised:** 01-Nov-2020 **Accepted:** 24-Dec-2020 **Published:** 26-Feb-2021

How to cite this article: Ahmed MS. Peribulbar injection of triamcinolone acetonide as an outpatient clinic procedure in the management of mild to moderate macular edema. J Med Sci Res 2021;4:55-62.

DME emerges from the blood–retinal barrier diabetes-induced breakdown, with consequent vascular leakage into the neural retina of fluid and circulating proteins [5]. Fluid extravasation into the neural retina leads to irregular retinal thickening and sometimes macula cystoid edema [6]. Clinically significant macular edema is characterized as DME meeting at least one of these criteria: thickening of the retina at or within 500 μm of the center of the macula; hard exudates at or within 500 μm of the center of the macula, if associated with thickening of the adjacent retina (not counting residual hard exudates remaining after the disappearance of retinal thickening), or any zone (s) of retinal thickening one disc area or larger, any part of which is within one disc diameter of the center of the macula [7].

Intraocular treatment modalities for diabetic eye disease include laser photocoagulation, intravitreal injections of antivascular endothelial growth factor (VEGF), steroid agents, and vitreo-retinal surgery [6]. Pan-retinal photocoagulation for PDR was first proposed in the 1960s based on the belief that thermal burns throughout the retinal periphery could promote the regression of retinal neovascularization, and its efficacy in reducing rates of severe vision loss in eyes with PDR was quickly and incontrovertibly demonstrated [8]. However, pan-retinal photocoagulation is an inherently destructive approach and is associated with well-documented adverse effects, including discomfort or pain [9], visual field loss [10], loss of color vision [11], reduction in contrast sensitivity [12], and choroidal effusions/detachment, leading to shallowing of the anterior angle, elevated intraocular pressure (IOP), and angle-closure glaucoma as well as possible misdirected or excessively intense burns resulting in lens damage, bleeding, or breaks in Bruch's membrane [9].

Meanwhile, in the modern era, multiple phase 3 clinical trials have demonstrated the superiority of intravitreal anti-VEGF injections to laser monotherapy to reduce vision loss and improve vision gain rates in eyes with DME [13,14]. A recent comparative efficacy study of the three most commonly utilized anti-VEGF agents revealed that aflibercept, bevacizumab, and ranibizumab effectively improved vision over 1 and 2 years of treatment for DME [15]. However, intravitreal anti-VEGF injections were found to have some complications, which are unrelated to the underlying ocular disease, including [16] endophthalmitis [17], intraocular inflammation [18], IOP elevation [19], and subconjunctival hemorrhage [20]. Rare ocular adverse events include anterior ischemic optic neuropathy after bevacizumab injection [21], retinal venous occlusions after bevacizumab injection [22], retinal artery occlusions [23], and sixth nerve palsy following bevacizumab injection [24].

Given the apparent role of inflammation in DME's pathogenesis, steroids have more recently been used for the treatment of DME [25]. Ophthalmic consequences of local application of steroids include cataract progression, elevated IOP, and when injected into the eye, a low risk of retinal detachment, vitreous hemorrhage, and endophthalmitis was reported [26].

Triamcinolone acetonide (TAA) is a synthetic corticosteroid whose empirical formula is $C_{24}H_{31}FO_6$ [27] and can be administered in multiple ways for ocular disease, including injection directly into the vitreous, under Tenon's capsule, or into the retrobulbar space [26]. Intravitreal TAA has been indicated in uveitis, vasculitis, proliferative vitreoretinopathy, macular degeneration, and macular edema [28–30]. This technique can be complicated with cataract development and progression [31] or elevated IOP [32]. Posterior subtenon injection of TAA has been reported to be an effective treatment for intermediate uveitis, cystoid, and DME [33]. Posterior subtenon injection is less invasive and safer, with a lower IOP elevation incidence than the intravitreal injection [34]. Peribulbar injections of corticosteroid have been used to treat a number of ocular conditions, such as DME [35], cystoid macular edema following cataract surgery, and most commonly, uveitis [36].

Peribulbar steroid injections have been used to treat DME either as monotherapy or as adjunctive therapy to laser [37,38]. Their short-term efficacy has been demonstrated with transient improvement to both retinal thickness and visual acuity [39]. Peribulbar administration of a modified formulation of TAA has been described to effectively reduce macular thickening owing to diffuse DME unresponsive to conventional grid laser photocoagulation [40]. This local therapy can be used in outpatient ophthalmic units, is a low-cost medication, is simple to use, and has no systemic adverse effects [41].

Possible ocular complications of peribulbar injections include retrobulbar hemorrhage, globe damage, optic nerve damage, and myotoxicity [42].

This study was conducted aiming to study the clinical effect and central macular thickness (CMT) decrease following outside clinic simple procedure of peribulbar injection of prepared TAA as a single procedure.

Patients and methods

Time frame

This study was conducted during the period of January 2019 to January 2020. The study procedure obtained was approval from our hospital's Institutional Review Board. Before data collection, administrative approval and official permits were obtained. Patients involved in the study received informed consent under a promise of data protection for them.

Study population

This study was conducted on 100 eligible eyes in 70 consecutive patients who attended the outpatient ophthalmology clinic during the study period.

Inclusion criteria

The following were the inclusion criteria:

(1) NPDR.
(2) With clinically significant edema affecting visual acuity or CMT between 300 and 400 μm on optical coherence tomography (OCT).

Exclusion criteria

The following were the inclusion criteria:

(1) Patients with poor visual acuity.
(2) Patients who have done any previous procedure for the management of clinically significant macular edema (laser or intravitreal injection of any material, or subtenon injection).
(3) Previous vitrectomy.
(4) DR with media opacification (dense cataract and corneal opacity).
(5) Double perforating trauma.
(6) Patients with chronic uveitis.
(7) Patients with glaucoma or steroid responder.
(8) Patients with rubeosis iridis.

Methods

Cases were assessed preoperatively. History taking included detailed medical history and detailed ocular history, including duration of symptoms, myopia, trauma, previous anterior segment operations (cataract surgery), and previous posterior segment procedures (laser photocoagulation, previous intravitreal or subtenon injection, previous vitrectomy). Visual acuity was evaluated by a nonaided and aided method after the correction of errors of refraction using ETDR charts. Anterior segment examination was performed using slit-lamp with IOP measurement by slit-lamp mounted applanation tonometer. Detailed fundus examination was performed by indirect ophthalmoscope using 20 D lens and scleral indentation with a thimble depressor and slit-lamp biomicroscopy by 78 D lenses with an assessment of the following: integrity of retinal vasculature, the integrity of retinal background, macular status, presence of vitreous hemorrhage, posterior vitreous face status, epiretinal membranes, retinal or choroidal detachment, and choroidal effusion. Fundus fluorescein angiography was performed for proper diagnosis and followed up if needed. Moreover, OCT was performed to select inclusion cases, determine the baseline CMT, and follow-up after the third injection.

The TAA injection techniques were standardized. For preparation, one vial of TAA suspension (40 mg/1 ml) was aspirated in a 5-ml syringe, and 4-ml sterile balanced salt solution was added to complete the syringe, which was left upright to precipitate the TAA particles and washout its preservative (to make it less toxic and harmful on retro-orbital fat and tissue) for 15 min or until all particles were precipitated. The upper part of the syringe fluid was clear, then the washed preservative and balanced salt solution were pushed out, leaving particles of TAA in the syringe. Overall, 0.5 ml of mepivacaine hydrochloride 3% was added as a local anesthetic and dissolved the TAA crystals to facilitate injection and minimize pain during and after injection. Tip of 3-ml syringe (needle size 24GX1) was used for peribulbar injection in the same way of peribulbar injection of anesthesia: one drop of topical anesthetic eye drops was instilled, the lower lid pulled laterally with digital palpation to the site of injection, and then the needle was inserted through the skin of lower lid at the junction between medial two-thirds and lateral one-third of inferior orbital margin after sterilization with local povidone-iodine 10% solution for 30–60 s or cleaning with alcohol 70% solution till drying, passing it backward and laterally for not more than 24 mm and always keeping it away from the globe by directing it slightly downward. The injection was performed at the level of the equator, as shown in Fig. 1.

These injections were given, as described previously, three times separated by 3-week interval.

Cases were followed-up one day after the procedure and at at 1, 2, and 3 weeks after each injection in the same way of preoperative assessment, that is, evaluation of visual acuity, anterior segment examination, detailed fundus examination, and IOP measurement. Any lower lid edema or ocular stiffness (local effect of TAA on retrobulbar fat) or lid hematoma after injection was recorded, and OCT was performed 1 month after the third injection.

Statistical analysis

Data were collected, revised, coded, tabulated, and analyzed using Statistical Package for Social Science (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp), version 20. The data were presented as numbers and percentages for the qualitative data; mean, SD, and ranges for the quantitative data with parametric distribution; and median with interquartile range for the quantitative data nonparametric distribution. A paired *t* test was used to compare two groups with quantitative data for before and after, and the parametric distribution and for the parametric data: Wilcoxon rank test were used in the comparison between two groups with quantitative data for before and after nonparametric distribution. The confidence interval was set to 95%, and the margin of error accepted was set to 5%. So, the *P* value was considered significant at the level of less than 0.05.

Results

A review of the included participants' sociodemographic characteristics revealed that 50% were males, and 50% were females. Overall, 71.4% of them had diabetes, and 28.6% of them were both diabetic and hypertensive. Their ages ranged from 24 to 76 years, with a mean of 54.27 ± 10.09 years (Table 1).

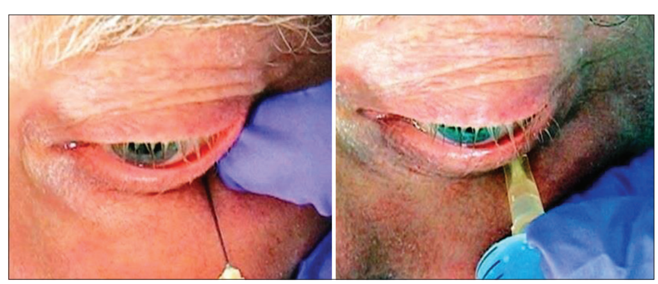

Figure 1: The method of peribulbar injection.

Follow-up of patients revealed that the mean values of best-corrected visual acuity (BCVA) showed gradual improvement over time (Fig. 2), with highly statistically significant improvements following each of the three injections compared with the baseline BCVA (Table 2).

Follow-up of patients also revealed that IOP's mean values showed a rise in the first week postinjection in each of the three injections, which gradually decreased (Fig. 3).

Moreover, comparison of follow-up mean values to baseline IOP revealed highly statistically reductions in the mean IOP, compared with baseline IOP, at 3 weeks following the first and third injections, as well as a highly statistically rise in the mean IOP, compared with baseline IOP, at 3 weeks following the second injection (Table 3).

Following each of the first and second injections, lower lid edema was noted in 100% of patients in the first week, which became mild edema in the second week and was resolved in the third week. Following the third injection, mild lower lid edema was noted in 100% of patients in the first week, which was resolved in the second and third weeks. Meanwhile, ocular motility was normal in 100% of patients in all follow-up visits following the three injections.

Eventually, follow-up of patients at 1 month following the third injection showed a highly statistically significant reduction in the mean CMT compared with its baseline level (Table 4 and Figs. 4–10).

Discussion

The present study revealed that 71.4% of the included patients had diabetes, and 28.6% were diabetic and hypertensive. A significant modifiable risk factor for DRR is hypertension [43]. Higher systolic blood pressure was also a risk factor for DR development in patients with diabetes [44]. This can be attributed to the destruction of the retinal capillaries' automatic regulatory mechanism by high blood glucose, which causes the capillary endothelial cells to be vulnerable to hypertension injury, resulting in capillary injury, decreased retinal blood flow, and ultimately retinopathy [45].

The present study revealed highly statistically significant improvements in BCVA following each of the three injections compared with the baseline BCVA. Similar findings of improvement in the visual acuity following repeated peribulbar injections of steroids were reported in previous studies [41,46]. The effect of steroids can explain this in reducing muscle and soft tissue edema, decreasing optic nerve compression [41].

The present study revealed that repeated injections were associated with changes in IOP, with highly statistically reductions in the mean IOP, compared with baseline IOP,

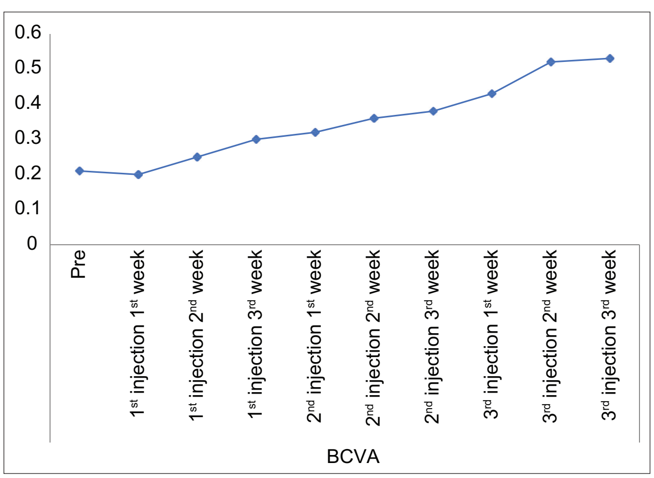

Figure 2: Follow-up of mean values of BCVA. BCVA, best-corrected visual acuity.

Table 1: Sociodemographic characteristics of the included cases

	n (%)
Sex	
Female	35 (50.0)
Male	35 (50.0)
Medical history	
DM	50 (71.4)
DM-HTN	20 (28.6)
Age (years)	
Mean±SD	54.27±10.09
Range	24-76

DM, diabetes mellitus; HTN, hypertension.

Table 2: Comparison of best-corrected visual acuity at 3 weeks following each of the three injections with baseline best-corrected visual acuity

BCVA	Baseline		Third week		Paired *t* test	
	Mean	SD	Mean	SD	*t*	*P*
1st injection	0.21	0.10	0.30	0.10	−10.162	0.001
2nd injection	0.21	0.10	0.38	0.13	−18.532	0.001
3rd injection	0.21	0.10	0.53	0.20	−18.974	0.001

BCVA, best-corrected visual acuity.

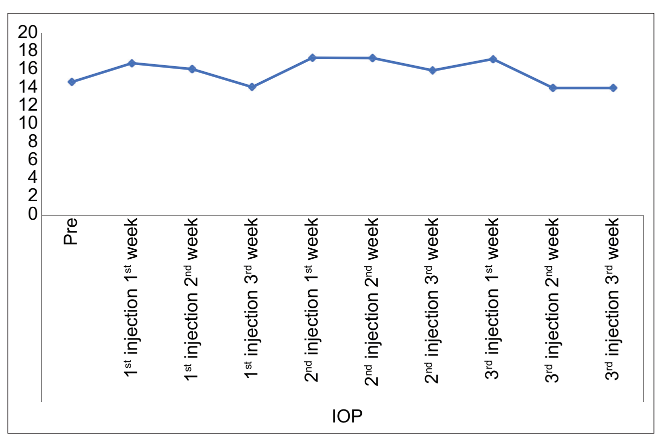

Figure 3: Follow-up of mean values of IOP. IOP, intraocular pressure.

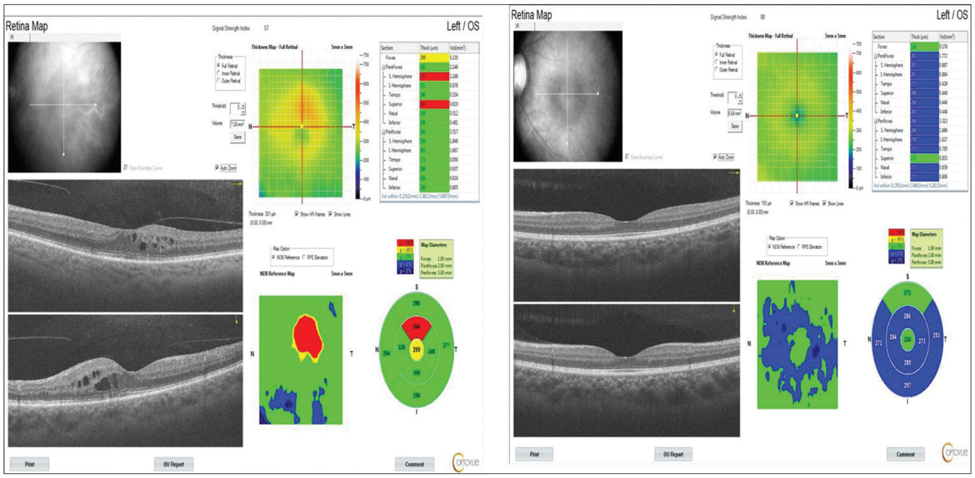

Figure 4: CT of preinjection and postinjection case no. 1. OCT, optical coherence tomography.

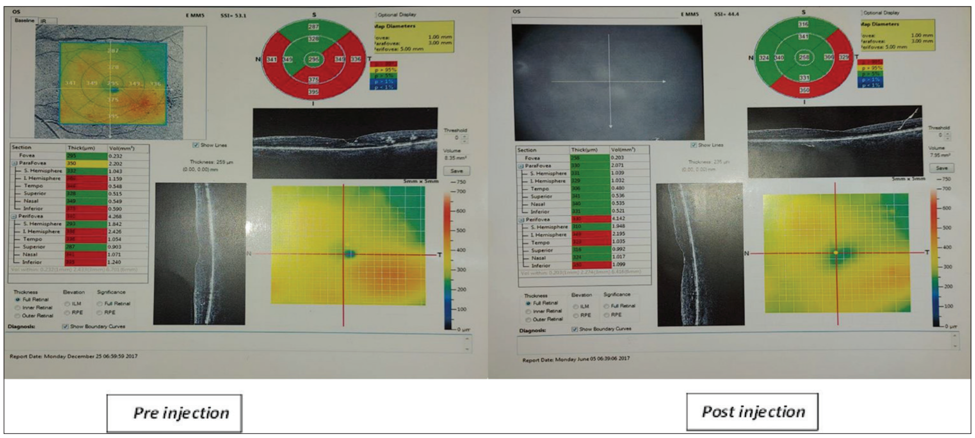

Figure 5: CT of preinjection and postinjection case no. 2. OCT, optical coherence tomography.

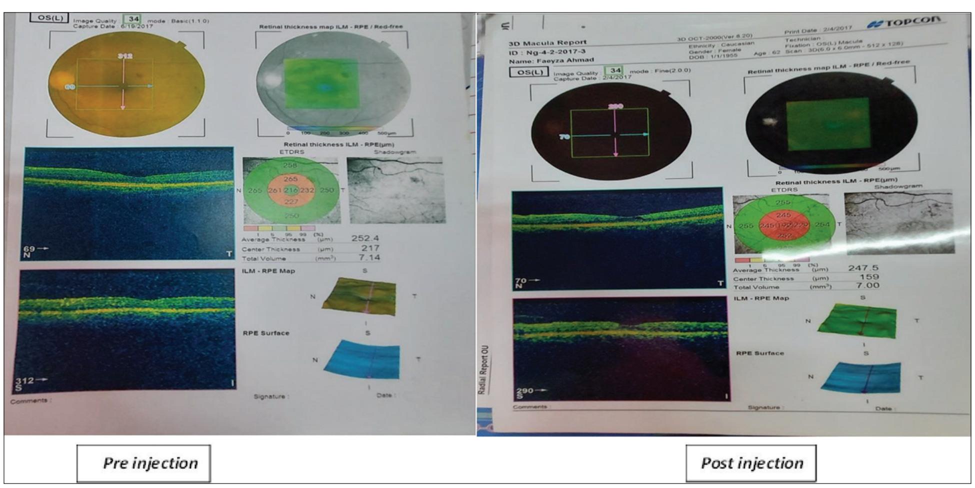

Figure 6: CT of preinjection and postinjection case no. 3. OCT, optical coherence tomography.

at 3 weeks following the first and third injections as well as a highly statistically rise in the mean IOP, compared with baseline IOP, at 3 weeks following the second injection. The most frequent adverse effect of triamcinolone ocular injections is increased IOP, but this tends to be transient and controlled in nearly all topical medication cases. Furthermore, the risk of inducing IOP increase is smaller with orbital steroids than subtenon or intravitreal injections [41].

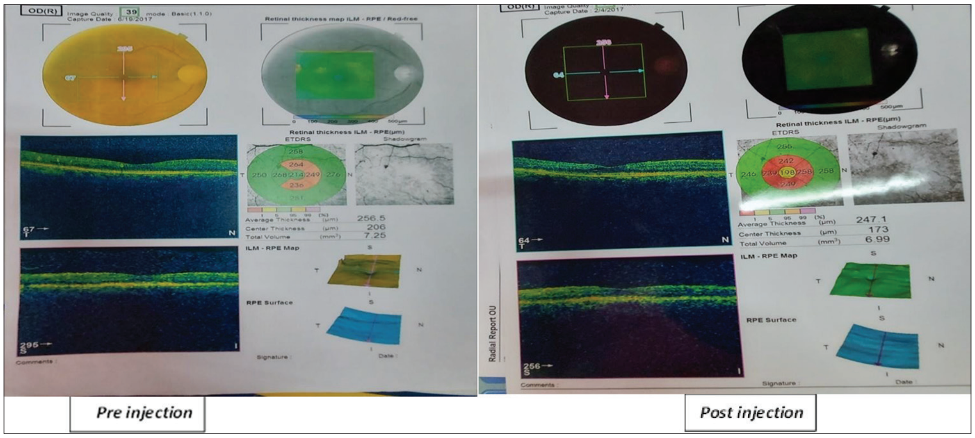

Figure 7: CT of preinjection and postinjection case no. 4. OCT, optical coherence tomography.

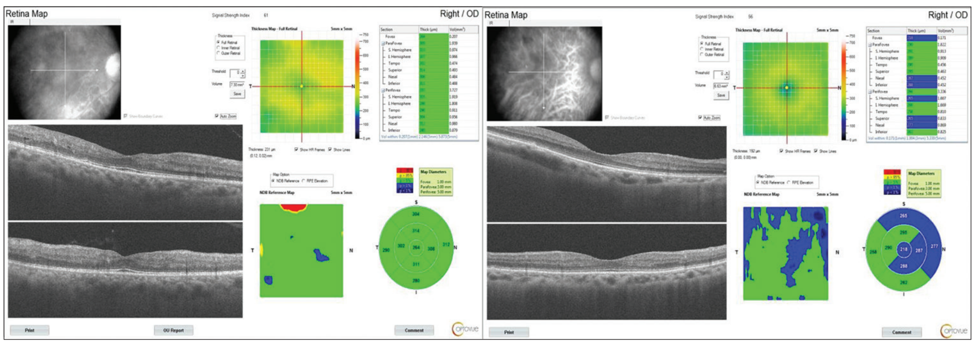

Figure 8: CT of preinjection and postinjection case no. 5. OCT, optical coherence tomography.

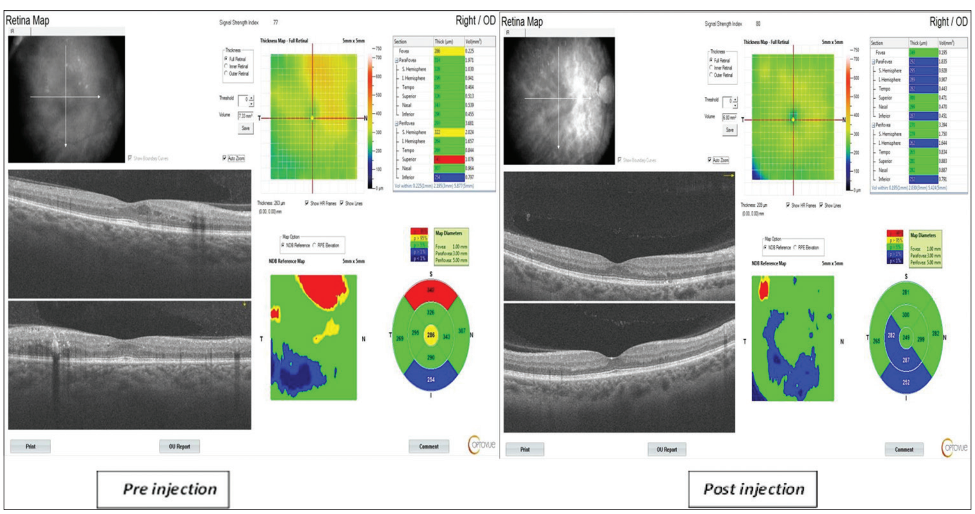

Figure 9: CT of preinjection and postinjection case no. 6. OCT, optical coherence tomography.

The present study revealed that lower lid edema was noted following TAA injections. This finding comes in line with that published in 2015 in which orbital edema was noted following surgery under peribulbar anesthesia. This finding was attributed to surgical trauma during the administration of the peribulbar block [47]. Trauma during injection and ecchymosis possibly aids the spread of infection; therefore, an aseptic technique with minimal soft tissue trauma is recommended [48]. Skin preparation with povidone-iodine 10% is recommended before administering peribulbar injections and should be left for ~5–10 min to sterilize the surface [49].

The present study revealed that repeated injections of TAA resulted in a significant reduction of CMT. TAA injections were performed as a simple, less-invasive outpatient clinic procedure. Injections of triamcinolone have shown excellent results in treating tissue inflammation-related symptoms, which is predicted

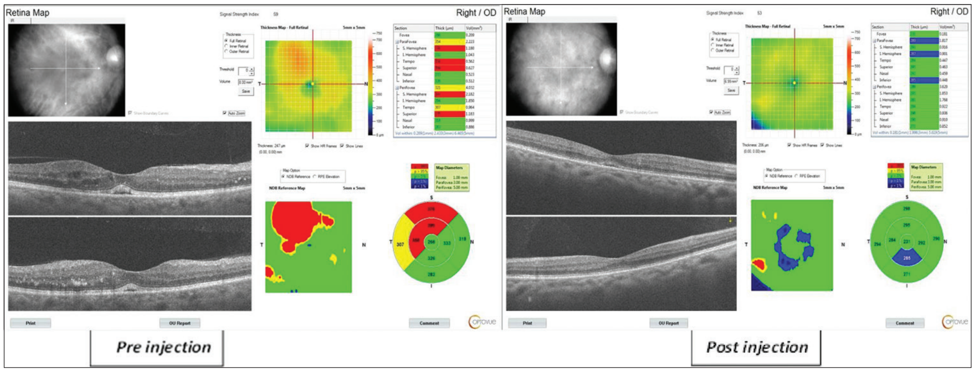

Figure 10: CT of preinjection and postinjection case no. 7. OCT, optical coherence tomography.

Table 3: Comparison of intraocular pressure at 3 weeks following each of the three injections to baseline intraocular pressure

IOP	Baseline		Third week		Paired *t* test	
	Mean	SD	Mean	SD	*t*	*P*
1st injection	14.66	0.63	14.11	0.47	6.171	0.001
2nd injection	14.66	0.63	15.94	0.29	−14.078	0.001
3rd injection	14.66	0.63	14.01	0.12	8.750	0.001

IOP, intraocular pressure.

Table 4: Comparison of central macular thickness at 1 month following the third injection with baseline central macular thickness

	Minimum	Maximum	Mean	SD
Pre/CMT	265	410	372.95	30.69
1 month after third injection/CMT	217	322	250.87	24.78
Paired *t* test		40.731		
P		0.001		

CMT, central macular thickness.

scientifically because steroids are effective anti-inflammatory drugs [41]. Results of previous studies evaluating corticosteroids injections for DME have been inconsistent. Entezari *et al.* [50] as well as Bonini-Filho *et al.* [51] found no benefit for CMT. Meanwhile, Tunc *et al.* [52] reported an improvement in macular edema. Furthermore, Cardillo *et al.* [39] reported a decrease in mean CMT at 3 months.

Considering the weaknesses of the present study, the outcomes should be interpreted with caution. First, there was a relatively small sample size, which did not provide much statistical strength. Second, the selected procedure was not evaluated in comparison with other available treatment modalities. Finally, the follow-up was limited to 1 month following the last injection.

Conclusion

In this study, repeated peribulbar injections of TAA, as an outpatient, less-invasive procedure, have been shown to be a safe and effective treatment modality for DME, as it has achieved success in the significant reduction of the CMT.

Recommendations

Peribulbar triamcinolone injections should be regarded as a treatment for mild to moderate DME. Multicenter randomized trials must be performed comparing this therapy to other available and well-known modality treatments. More extended follow-up periods are needed in future studies.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Crawford TN, Alfaro DVIII, Kerrison JB, Jablon EP. Diabetic retinopathy and angiogenesis. Curr Diabetes Rev 2009; 5:8–13.
2. Cai X, McGinnis JF. Diabetic retinopathy: animal models, therapies and perspectives. J Diabetes Res 2016; 2016:3789217.
3. Leasher JL, Bourne RR, Flaxman SR, Jonas JB, Keeffe J, Naidoo K, *et al*. Global estimates on the number of people blind or visually impaired by diabetic retinopathy: a meta-analysis from 1990 to 2010. Diabetes Care 2016; 39:1643–1649.
4. Matthews DR, Stratton IM, Aldington SJ, Holman RR, Kohner EM. Risks of progression of retinopathy and vision loss related to tight blood pressure control in type 2 diabetes mellitus: UKPDS 69. Arch Ophthalmol 2004; 122:1631–1640.
5. Stitt AW, Curtis TM, Chen M, Medina RJ, McKay GJ, Jenkins A, *et al*. The progress in understanding and treatment of diabetic retinopathy. Prog Retin Eye Res 2016; 51:156–186.
6. Duh EJ, Sun JK, Stitt AW. Diabetic retinopathy: current understanding, mechanisms and treatment strategies. JCI Insight 2017; 2:e93751.
7. Mathew C, Yunirakasiwi A, Sanjay S. Updates in the management of diabetic macular edema. J Diabetes Res 2015; 2015:794036.
8. The Diabetic Retinopathy Study Research Group. Preliminary report on effects of photocoagulation therapy. Am J Ophthalmol 1976; 81:383–396.
9. Deschler EK, Sun JK, Silva PS. Side effects and complications of laser treatment in diabetic retinal disease. Semin Ophthalmol 2014; 29:290–300.
10. Henricsson M, Heijl A. The effect of panretinal laser photocoagulation on visual acuity, visual fields and on subjective visual impairment in preproliferative and early proliferative diabetic retinopathy. Acta Ophthalmol 1994; 72:570–575.
11. Birch J, Hamilton AM. Xenon arc and argon laser photocoagulation in the treatment of diabetic disc neovascularization: Part 2. Effect on colour vision. Trans Ophthalmol Soc UK 1981; 101:93–99.

12. Higgins KE, Meyers SM, Jaffe MJ. Temporary loss of foveal contrast sensitivity associated with panretinal photocoagulation. Acta Ophthalmol 1986; 104:997–1003.
13. Brown DM, Nguyen QD, Marcus DM, Boyer DS, Patel S, Feiner L, *et al*. Long-term outcomes of ranibizumab therapy for diabetic macular edema: The 36-month results from two phase III trials: RISE and RIDE. Ophthalmology 2013; 120:2013–2022.
14. Heier JS, Korobelnik JF, Brown DM, Erfurth US, Do DV, Midena E, *et al*. Intravitreal aflibercept for diabetic macular edema: 148-week results from the VISTA and VIVID studies. Ophthalmology 2016; 123:2376–2385.
15. Wells JA, Glassman AR, Ayala AR, Jampol LM, Bressler NM, Bressler SB, *et al*. Aflibercept, bevacizumab or ranibizumab for diabetic macular edema: two-year results from a comparative effectiveness randomized clinical trial. Ophthalmology 2016; 123:1351–1359.
16. Falavarjani KG, Nguyen QD. Adverse events and complications associated with intravitreal injection of anti-VEGF agents: a review of literature. Eye (Lond) 2013; 27:787–794.
17. McCannel CA. Meta-analysis of endophthalmitis after intravitreal injection of anti-vascular endothelial growth factor agents. Retina 2011; 31:654–661.
18. Tolentino M. Systemic and ocular safety of intravitreal anti-VEGF therapies for ocular neovascular disease. Surv Ophthalmol 2011; 56:95–113.
19. Hoang QV, Mendonca LS, Della Torre KE, Jung JJ, Tsuang AJ, Freund KB. Effect on intraocular pressure in patients receiving unilateral intravitreal anti-vascular endothelial growth factor injections. Ophthalmology 2012; 119:321–326.
20. Ladas ID, Karagiannis DA, Rouvas AA, Kotsolis AI, Liotsou A, Vergados I. Safety of repeat intravitreal injections of bevacizumab versus ranibizumab: our experience after 2,000 injections. Retina 2009; 29:313–318.
21. Ganssauge M, Wilhelm H, Bartz-Schmidt KU, Aisenbrey S. Nonarteritic anterior ischemic optic neuropathy (NA-AION) after intravitreal injection of bevacizumab (Avastin) for treatment of angoid streaks in pseudoxanthoma elasticum. Graefes Arch Clin Exp Ophthalmol 2009; 247:1707–1710.
22. Mansour AM, Bynoe LA, Welch JC, Pesavento R, Mahendradas P, Ziemssen F, *et al*. Retinal vascular events after intravitreal bevacizumab. Acta Ophthalmol 2010; 88:730–735.
23. von Hanno T, Kinge B, Fossen K. Retinal artery occlusion following intravitreal anti-VEGF therapy. Acta Ophthalmol 2010; 88:263–266.
24. Cakmak HB, Toklu Y, Yorgun MA, Simşek S. Isolated sixth nerve palsy after intravitreal bevacizumab injection. Strabismus 2010; 18:18–20.
25. Wenick AS, Bressler NM. Diabetic macular edema: current and emerging therapies. Middle East Afr J Ophthalmol 2012; 19:4–12.
26. Couch SM, Bakri SJ. Intravitreal triamcinolone for intraocular inflammation and associated macular edema. Clin Ophthalmol 2009; 3:41–47.
27. Mansoor S, Kuppermann BD, Kenney MC. Intraocular sustained-release delivery systems for triamcinolone acetonide. Pharm Res 2009; 26:770–784.
28. Jonas JB, Kressig I, Kamppeter B, Degenrin RF. Intravitreal triamcinolone acetonide for the treatment of intraocular oedematous and neovascular diseases. Ophthalmology 2004; 101:113–120.
29. Munir WM, Pulido JS, Sharma MC, Buerk BM. Intravitreal triamcinolone for treatment of complicated proliferative diabetic retinopathy and proliferative vitreoretinopathy. Can J Ophthalmol 2005; 40:598–604.
30. Gillies MC, Larsson J. The effect of intravitreal triamcinolone on foveal edema in exudative macular degeneration. Am J Ophthalmol 2007; 144:134–136.
31. Thompson JT. Cataract formation and other complications of intravitreal triamcinolone for macular edema. Am J Ophthalmol 2006; 141:629–637.
32. Galor A, Margolis R, Brasil OMF, Perez VL, Kaiser PK, Sears JE, *et al*. Adverse events after intravitreal triamcinolone in patients with and without uveitis. Ophthalmololgy 2007; 114:1912–1918.
33. Ohguro N, Okada AA, Tano Y. Trans-Tenon's retrobulbar triamcinolone infusion for diffuse diabetic macular edema. Graefes Arch Clin Exp Ophthalmol 2004; 242:444–445.
34. Choi YJ, Oh IK, Oh JR, Huh K. Intravitreal versus posterior subtenon injection of triamcinolone acetonide for diabetic macular edema. Korean J Ophthalmol 2006; 20:205–209.
35. Bakri SJ, Kaiser P. Posterior subtenon triamcinolone acetonide for refractory diabetic macular edema. Am J Ophthalmol 2005; 139:290–294.
36. Ray S, D'Amico DJ. Pseudophakic cystoid macular edema. Semin Ophthalmol 2002; 17:167–180.
37. Chew E, Strauber S, Beck R, Aiello LP, Antoszyk A, Bressler N, *et al*. Randomized trial of peribulbar triamcinolone acetonide with and without focal photocoagulation for mild diabetic macular edema: a pilot study. Ophthalmology 2007; 114:1190–1196.
38. Yalcinbayir O, Gelisken O, Kaderli B, Avci R. Intravitreal versus sub-tenon posterior triamcinolone injection in bilateral diffuse diabetic macular edema. Ophthalmologica 2011; 225:222–227.
39. Cardillo JA, Melo LA, Costa RA, Skaf M, Belfort RJr, Souza-Filho AA, *et al*. Comparison of intravitreal versus posterior sub-Tenon's capsule injection of triamcinolone acetonide for diffuse diabetic macular edema. Ophthalmology 2005; 112:1557–1563.
40. Lanzetta P, Veritti D. The role of steroids in the treatment of diabetic macular edema. Retina Today 2009; 2009:41–44.
41. Bordaberry M, Marques DL, Pereira-Lima JC, Marcon IM, Schmid H. Repeated peribulbar injections of triamcinolone acetonide: a successful and safe treatment for moderate to severe Graves' ophthalmopathy. Acta Ophthalmol 2009; 87:58–64.
42. Jaichandran VV. Ophthalmic regional anaesthesia: a review and update. Indian J Anaesth 2013; 57:7–13.
43. Mohamed Q, Gillies MC, Wong TY. Management of diabetic retinopathy: a systematic review. JAMA 2007; 298:902–916.
44. Cui Y, Zhang M, Zhang L, Zhang L, Kuang J, Zhang G, *et al*. Prevalence and risk factors for diabetic retinopathy in a cross-sectional population-based study from rural southern China: Dongguan Eye Study. BMJ Open 2019; 9:e023586.
45. Bhargava M, Ikram MK, Wong TY. How does hypertension affect your eyes? J Hum Hypertens 2012; 26:71–83.
46. Ebner R, Devoto M, Weil D, Bordaberry M, Mir C, Martinez H, *et al*. treatment of thyroid associated ophthalmopathy with peribulbar injections of triamcinolone. Br J Ophthalmol 2004; 88:1380–1386.
47. Mukherjee C, Mitra A, Mushtaq B. Orbital cellulitis following cataract surgery under peribulbar anaesthesia. GMS Ophthalmol Cases 2015; 5:Doc02.
48. Varma D, Metcalfe TW. Orbital cellulitis after peribulbar anaesthesia for cataract surgery. Eye (Lond) 2003; 17:105–106.
49. Sharma V, Benger R, Wechsler AW, Kaufman G, Burfitt-Williams GC. Orbital cellulitis following cataract surgery. Clin Exp Ophthalmol 2005; 33:434–435.
50. Entezari M, Ahmadieh H, Dehghan MH, Ramezani A, Bassirnia N, Anissian A. Posterior sub-tenon triamcinolone for refractory diabetic macular edema: a randomized clinical trial. Eur J Ophthalmol 2005; 15:746–750.
51. Bonini-Filho MA, Jorge R, Barbarosa JC, Calucci D, Cardillo HA, Costa RA. Intravitreal injection versus sub-tenon's infusion of triamcinolone acetonide for refractory diabetic macular edema: a randomized clinical trial. Invest Ophthalmol Vis Sci 2005; 46:3845–3849.
52. Tunc M, Onder HI, Kaya M. Posterior sub-tenon's capsule triamcinolone injection combined with focal laser photocoagulation for diabetic macular edema. Ophthalmology 2005; 112:1086–1091.