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Research Article

TO EVALUATE THE EFFECT OF INTRAVITREAL INJECTION OF TRIAMCINOLONE ACETONIDE IN RECALCITRANT MACULAR DISORDERS

AMIT K. JAIN[1], SEEMA JAIN[2], DADAN JI PANDEY[1], RAJKUMAR SHARMA[3]

[1]Department of Ophthalmology, Saraswathi Institute of Medical Sciences, Pilkhuwa, Hapur, Ghaziabad - 245 304, Uttar Pradesh, India.[2]Department of Pharmacology, University College of Medical Sciences and Guru Tegh Bahadur Hospital, Delhi - 110 095, India.[3]Department of Ophthalmology, Sahai Hospital and Research centre, Bhabha Marg, Moti Dungri, Jaipur - 302 004, Rajasthan, India. Email: dramitjain75@gmail.com

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ABSTRACT

Objectives: Recalcitrant macular disorders are those retinal conditions which, though treated by various medical and surgical modalities, but showed no improvement in symptoms or visual acuity or both. The present study was carried out to evaluate the efficacy of intravitreal triamcinolone acetonide (TA) injection in patients with these recalcitrant macular disorders.

Methods: This prospective and interventional study included 40 patients (40 eyes) having recalcitrant macular disorders. Complete ophthalmic examination such as measurement of intraocular pressure (IOP), visual acuity (log minimal angle of resolution [MAR] units), fundus photography with fluorescein angiography were carried out before and after intravitreal injection of TA. The patients received an intravitreal injection of TA (10 mg) for diabetic macular edema (n=14), age-related macular degeneration (n=13), pars plana cystoid macular edema (CME) (n=5), vascular diseases (n=3), central chorioretinopathy (n=3), and idiopathic CME (n=2). The follow-up was done on day 1, day 7, 1 month, 2 month and 4-month intervals.

Results: The mean visual acuity at 2 months (1.12±0.45 log MAR units), and 4 months (1.08±0.46 log MAR unit) after the injection were significantly better than baseline measurements (1.32±0.3 log MAR units). The mean baseline IOP was 12.5±2.9 mmHg. The IOP significantly increased after the injection at day 1 and day 7; however, the change in IOP at 1 month, 2 months, and 4 months was not statistically significant.

Conclusion: The results indicate that intravitreal injection of TA in patients with recalcitrant macular disorders caused significant improvement of visual acuity in 10 mg dose.

Keywords: Intravitreal triamcinolone acetonide, Macular edema, Visual acuity, Intraocular pressure.

INTRODUCTION

The recalcitrant macular disorders are those who respond poorly to available treatment modalities and include conditions such as cystoid macular edema (CME), diabetic macular edema, macular edema following branch retinal vein occlusion (BRVO) and central retinal vein occlusion (CRVO) or because of age related macular degeneration (ARMD), chronic central serous retinopathy, and macular edema of hypotony. Though most of these conditions are not treatable, but some amount of visual rehabilitation can be achieved in these recalcitrant macular disorders with an intraocular injection of specific medications. Triamcinolone acetonide (TA) is a synthetic glucocorticosteroid used as an anti-inflammatory and an immunomodulatory agent in the management of various diseases [1,2].

The use of TA as an intravitreal injection for treatment of various diseases of the posterior segment of the eye has increased in recent past years [3,4]. It has been used for the treatment of edematous, proliferative, and neovascular diseases of the eye such as macular edema due to CRVO [5,6], diabetic macular edema [7-10], exudative ARMD [11-15] neovascular glaucoma [16,17], chronic uveitic pre-phthisical ocular hypotony [18,19]. TA is considered safe and well tolerated and has been shown to be devoid of ocular toxicity in experimental and clinical studies [9,20,21] however, certain serious complications such as rise in intraocular pressure (IOP), endophthalmitis, glaucoma, retinal detachment, and cataract has been reported with the use of intravitreal TA [22-27].

The present prospective study was performed to assess the effectiveness and safety of intravitreal injection of TA for the treatment of recalcitrant macular disorders.

METHODS

Study design

This prospective clinical interventional study was carried out in Sahai Hospital and Research Centre in Jaipur, India. The Ethics Committee of the Institute approved the study. Before recruitment of patients, the study protocol was completely explained to patients and written informed consent was obtained from each patient. The patients were free to withdraw from the study at any time without providing reasons whatsoever; however, all such cases were recorded stating the reasons, if any.

Patient selection criteria

Patients presented with recalcitrant macular disorders such as ARMD, CME, Eales' disease, diabetic retinopathy, hypertensive retinopathy, CRVO, BRVO, pars planitis with suspected CME, posterior scleritis with macular involvement, sub retinal neovascular membrane (SRNVM) and macular conditions previously treated by medical or surgical modalities but showing no improvement in symptoms and visual acuity or both were eligible for inclusion in the study. The patients who were having associated debilitating systemic illness, glaucoma, chorioretinitis, optic nerve disorders, corneal pathologies, mass lesion of eye or orbit, dense cataract, and visual acuity better than 6/36 were not included in the study.

Treatment protocol

Eligible patients, who fulfilled the inclusion/exclusion criteria and expressed willingness to participate in the study, were enrolled for the study. All patients were informed about the nature of the study and possible complications and outcomes of the procedure. Before any treatment demographic profile, clinical symptoms and signs of all

patients were recorded. A detailed general and ophthalmic examination was carried out in all patients. Eyes were examined for visual acuity by using the early treatment diabetic retinopathy study (ETDRS) chart, and IOP was measured using noncontact tonometer (NCT) NT-3000 Nidek. The number of letters read by the patient in the chart was converted to log minimal angle of resolution (MAR) units.

Slit lamp biomicroscopy, indirect ophthalmoscopy was done, and fundus chart was made in each case. Fundus photography done using nidek camera and fluorescein angiography was performed in all cases, and photographs were taken in both early and late phases.

For TA injection, each eye was cleaned using povidone - iodine solution and then draped with sterile aseptic precautions in the operation theater. Infero-temporal quadrant and infero-nasal quadrant were selected for injection in the right and left eye, respectively. The lid speculum was placed after instilling 4% xylocaine. 0.25 ml (10 mg) aqueous suspension of TA (D-cort, DWD Pharmaceutical Private Limited, Mumbai, India) was drawn in 1.0 ml syringe fitted with a 26-gauge needle. The drug was injected through marked site only 2-3 mm deep, so that drug suspension remained in the inferior vitreous cavity and does not interfere in visual axis. Then needle was withdrawn slowly while keeping the site of injection pinched with toothed forceps. Immediately after injection all patients were observed for complications such as vitreous hemorrhage, subconjunctival leakage of drug or prolapsed of vitreous through the injection site. In case of any complication, anterior chamber paracentesis was performed. Ciprofloxacin eye drop and analgesic were given following injection. The patients were kept under observation for about 24 hrs after injection. All patients were reexamined at first post-injection day. The anterior segment was examined with slit lamp for any change in IOP (corneal edema and inflammation). Visual acuity was measured and fundus examination done to rule out any immediate complication. After examination, patients were discharged with topical antibiotic and oral analgesics for 3 days. They were advised to come for follow-up at 1 week, 1 month, 2 months, and 4 months. At each follow-up visit, the patients were examined for visual acuity using ETDRS charts and IOP changes using NCT. In addition, anterior segment examination and fundus examination were done using slit lamp and indirect ophthalmoscope, respectively. If any complication or rise in IOP was noticed during the follow-up period, appropriate medical or surgical treatment was provided to patients.

Statistical analysis

Statistical analyzes were made using Graph pad prism software. Nonparametric test Wilcoxon Mann–Whitney rank sum test was used to find the association between variables. A $p<0.05$ was considered statistically significant.

RESULTS

The study included 40 eyes of 40 patients (17 males and 23 females) who received an intravitreal injection of TA as treatment for diffuse macular edema (n=14), age-related macular degeneration (n=13), pars plana cystoid macular edema (n=5), vascular diseases (n=3), central CHR (n=3), and idiopathic CME (n=2). Mean age of the patients was 51.3±15.8 years (range 16-75 years; median, 52.0 years) (Table 1).

The mean best corrected visual acuity (BCVA) was 1.32±0.3 log MAR units prior to treatment. The mean visual acuity at day 1, day 7, and 1 month was 1.33±0.4, 1.23±0.40, and 1.16±0.44 log MAR units, respectively. There was no significant difference in visual acuity at day 1, day 7, and at 1 month when compared with baseline visual acuity. However, difference in mean visual acuity at 2 month (1.12±0.45 log MAR units) and 4 month (1.08±0.46 log MAR unit) follow-up was found to be statistically significant ($p=0.04$ and $p=0.01$) when compared with baseline visual acuity (Fig. 1).

Mean pre-injection visual acuity in DME and ARMD patients was 1.31±0.42 and 1.294±0.27 log MAR units, respectively. At 4 month follow-up, the mean visual acuity was 1.109±0.49 and 1.073±0.32 log MAR units, respectively. Mean pre-injection visual acuity in patients of pars plana CME was 1.065±0.25 log MAR units. Visual acuity improvement to 0.863±0.56 log MAR units was noted at 4 months ($p<0.05$). No change in mean visual acuity at 4 months was noted in cases of vascular disorders when compared with pre-injection mean visual acuity. In central CHR and idiopathic CME cases mean visual acuity improved to 1.408±0.5 logMAR units and 0.778±0.1 log MAR units, respectively from baseline (pre-injection) visual acuity value of 1.52±0.57 log MAR units and 1.0±0.5 log MAR units, respectively (Fig. 2).

Table 1: Patient demographics in the study

Age (years)	
Range	16-75
Mean±SD	51.3±15.8
Gender (*n* (%))	
Male	17 (42.5)
Female	23 (57.5)
Number of eyes (*n* (%))	
Diffuse macular edema	14 (35)
Age-related macular degeneration	13 (32.5)
Pars plana CME	5 (12.5)
Vascular diseases	3 (7.5)
Central CHR	3 (7.5)
Idiopathic CME	2 (5)

CME: Cystoid macular edema, SD: Standard deviation, CHR: Chorioretinopathy

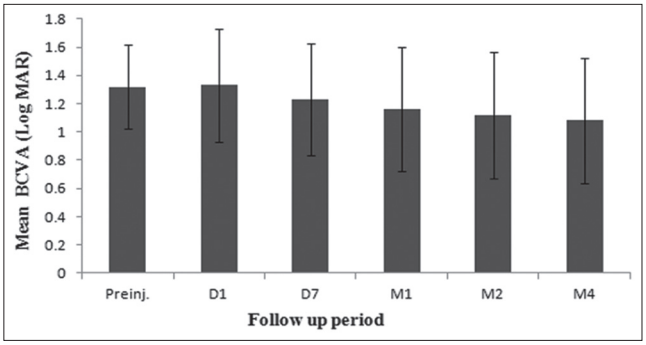

Fig. 1: Mean best corrected visual acuity (log minimal angle of resolution value) following intravitreal triamcinolone acetonide injection, pre-inj: Pre-injection, D1: Post-injection day 1, D7: Post-injection day 7, M2: Post-injection 2 months, M4: Post-injection 4 months

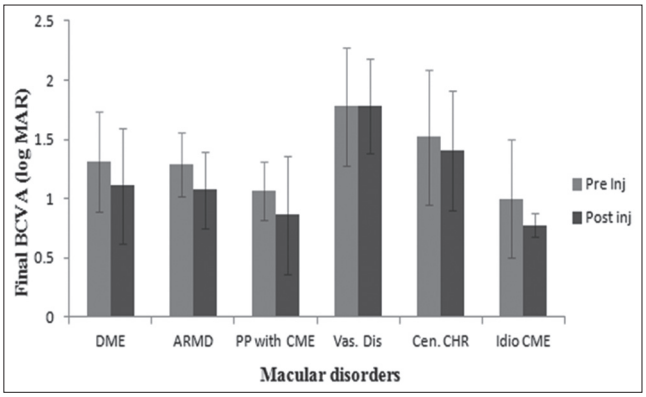

Fig. 2: Mean pre and post injection best corrected visual acuity (log minimal angle of resolution) among different macular disorders following intravitreal triamcinolone acetonide injection, Pre-inj: Pre-injection, Post-inj: Post-injection, DME: Diabetic macular edema, ARMD: Age related macular degeneration, PP with CME: Pars plana CME, Vas. Dis: Vascular diseases; Cen CHR: Central chorioretinopathy; Idio CME: Idiopathic CME.

Mean IOP prior to the treatment was 12.5±2.9 mmHg (median, 12.4 mmHg). After injection IOP increased significantly from 12.5±2.9 mmHg to 18.59±8.06 mmHg (median 18.6 mmHg) on day 1 (p=0.001) and 16.64±7.2 mmHg (median 15.0 mmHg) on day 7 (p=0.01). During the follow-up at 1 month, 2 months, and 4 months, the mean IOP were 14.75±4.0 mmHg (median 14.3 mmHg), 14.01±3.79 mmHg (median 13.2 mmHg), and 13.64±3.8 mmHg (median 13.0 mmHg), respectively. There were no significant difference in the mean IOP changes before injection or at 1 month, 2 months, and 4 months after injection (Fig. 3). IOP value in one patient of DME on day 1 after injection reached to 60 mmHg who eventually lost to follow-up after developing sterile endophthalmitis at 1-week follow-up.

Out of 40 patients, 29 patients on fundus examination shown macular edema and rest presented with SRNVM. At 2 month post-injection follow-up, macular edema found to be decreased in 48.2% cases, increased in 6.8% cases, and remained unchanged in 44.8% cases. While at 4 months follow-up edema decreased in 20.6% cases, increased in 20.6% cases, and remained unchanged in 58.6% cases, indicating deterioration. Status of SRNVM was also noticed in follow-up at 1 month. Lesion size was found to be decreased in 50% patients, and no change was noticed in 50% patients. While at 4 months follow-up SRNVM size decreased in 22.2% cases, increased in 22.2%, and remained unchanged in 55.6% patients.

The mean pre injection and post-injection BCVA at 4 months in patients who presented with macular edema were 1.334±0.39 and 1.173±0.48 log MAR units, respectively. Among the SRNVM cases, mean pre- and post-injection (at 4 months) BCVA was 1.001±0.3 and 1.087±0.37 log MAR units, respectively. The improvement in BCVA in macular edema cases was statistically significant (p<0.01) However, no statistical significant improvement in BCVA was found in SRNVM cases.

DISCUSSION

Vision loss in recalcitrant macular disorders is primarily occurring as a result of macular edema. There is a breakdown of the blood retinal barrier due to capillary leakage and abnormal proliferation of intraocular cells. In addition, the release of vascular endothelial growth factor, cytokines, and other inflammatory mediators play an important role in the pathophysiology of macular edema [28,29]. In recent past use of corticosteroids as an anti-inflammatory agent has shown promising results in the treatment of macular diseases [30,31]. Corticosteroids help in maintenance of blood-retinal barrier, as well as facilitate reabsorption of exudates. In addition, these agents have been shown to inhibit the release of vascular endothelial growth factor and synthesis of prostaglandins and leukotrienes, thus suppressing early as well as the late manifestation of inflammation [27,29,32-34].

TA is one of the synthetic corticosteroid that has been used in the treatment of many ocular diseases because of its anti-inflammatory, anti-angiogenic, and anti-permeability actions [35-37]. It can be injected in subconjunctival, subtenon, or retrobulbar space. However, with these applications sufficient intraocular concentration is not achieved, thus to achieve desired therapeutic intraocular concentration it is used as intravitreal injection [27,38,39]. Throughout past decade, TA in the form of intravitreal injection in dose of 4 mg or 20-25 mg has been advocated for the management of many inflammatory, neovascular, and macular edematous conditions of the eye [40-42].

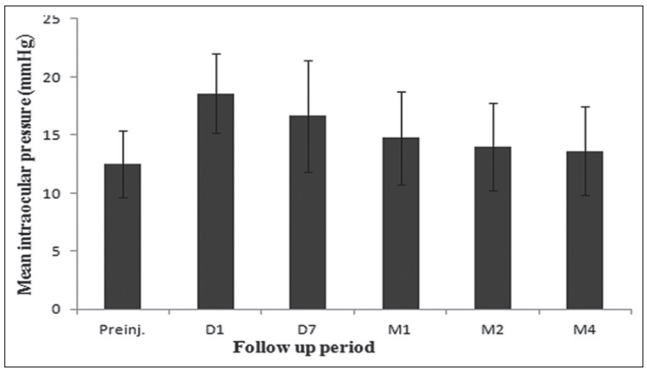

Fig. 3: Mean intraocular pressure changes following intravitreal triamcinolone acetonide injection, pre-inj: Pre-injection, D1: Post-injection day 1, D7: Post-injection day 7, M2: Post-injection 2 months, M 4: Post-injection 4 months

The present study prospectively evaluated efficacy and safety of intravitreal TA in the dose of 10 mg in the treatment of recalcitrant macular disorders. The study included 14 eyes with diabetic macular edema, 13 eyes with age-related macular degeneration, 5 eyes with pars plana cystoid macular edema, 3 eyes with central CHR, 2 eyes with idiopathic CME, and 3 eyes with vascular diseases. The results indicate that a 10 mg dose of intravitreal injection of TA has a beneficial effect in improving the visual outcome up to 4 months follow-up without any significant rise in IOP. In patients of diabetic macular edema and ARMD change of mean visual acuity of 0.21 (16%) and 0.22 (16.75%), respectively was found at 4 months. Maximum change in visual acuity of 0.22 (22.2%) was seen in patients of idiopathic CME while no change in visual acuity seen in patients with vascular disorders. These results are in agreement with the findings of other previous studies. Choi *et al.* [43] reported that visual acuity improved by 0.160 (21.8%) at 1 month and 0.196 (26.8%) at 4 months in patients of diabetic macular edema. Similarly, Jonas *et al.* [4] reported improvement of 0.15 (15.3%) and 0.19 (19.3%) visual acuity at 1 month and 3 months after injection, respectively. In another study, Jonas *et al.* 2003 showed significant improvement in visual acuity after 2-5 months of intravitreal injection of TA in dose of 25 mg. In ARMD patients, intravitreal TA in the dose of 4 and 20-25 mg has been found to significantly improve the vision in various clinical studies [12,15,44]. Previous clinical and experimental studies have reported that intravitreal TA injection is a safe procedure [3,9,20,8] however, elevation in IOP is considered most common complication following intravitreal TA injection [43,45,46]. Intravitreal TA in 10 mg dose caused an initial significant rise of IOP at day 1 follow-up which gradually normalized to pre-injection values at 4 months follow-up. Other injection related complications such as retinal detachment, retinal necrosis, choroidal detachment, and vitreous hemorrhage were not observed in any patient. Our study has certain limitations as it has no control group, and relatively small number of patients was included in the study. However, the current study differs from previous studies in that we used 10 mg TA to investigate the effect in macular disorders instead of 4 mg or 20-25 mg dose of TA. The results of this study suggest that 10 mg of intravitreal TA might have a beneficial effect in the treatment of macular disorders refractory to previous therapies and side effects mainly IOP rise is insignificant.

REFERENCES

1. Gopal L, Sharma T. Use of intravitreal injection of triamcinolone acetonide in the treatment of age-related macular degeneration. Indian J Ophthalmol 2007;55(6):431-5.
2. Sarao V, Veritti D, Boscia F, Lanzetta P. Intravitreal steroids for the treatment of retinal diseases. ScientificWorldJournal 2014;2014:989501.
3. Tewari HK, Sony P, Chawla R, Garg SP, Venkatesh P. Prospective evaluation of intravitreal triamcinolone acetonide injection in macular edema associated with retinal vascular disorders. Eur J Ophthalmol 2005;15(5):619-26.
4. Jonas JB, Akkoyun I, Kreissig I, Degenring RF. Diffuse diabetic macular oedema treated by intravitreal triamcinolone acetonide. A comparative nonrandomized study. Br J Ophthalmol 2005;89:321-6.
5. Greenberg PB, Martidis A, Rogers AH, Duker JS, Reichel E. Intravitreal triamcinolone acetonide for macular oedema due to central retinal vein occlusion. Br J Ophthalmol 2002;86(2):247-8.
6. Karacorlu M, Ozdemir H, Karacorlu S. Intravitreal triamcinolone acetonide for the treatment of central retinal vein occlusion in young patients. Retina 2004;24(2):324-7.
7. Jonas JB, Söfker A. Intraocular injection of crystalline cortisone as adjunctive treatment of diabetic macular edema. Am J Ophthalmol 2001;132(3):425-7.
8. Martidis A, Duker JS, Greenberg PB, Rogers AH, Puliafito CA,

Reichel E, *et al.* Intravitreal triamcinolone for refractory diabetic macular edema. Ophthalmology 2002;109(5):920-7.
9. Jonas JB, Kreissig I, Söfker A, Degenring RF. Intravitreal injection of triamcinolone for diffuse diabetic macular edema. Arch Ophthalmol 2003;121(1):57-61.
10. Massin P, Audren F, Haouchine B, Erginay A, Bergmann JF, Benosman R, *et al.* Intravitreal triamcinolone acetonide for diabetic diffuse macular edema: Preliminary results of a prospective controlled trial. Ophthalmology 2004;111(2):218-24.
11. Penfold PL, Gyory JF, Hunyor AB, Billson FA. Exudative macular degeneration and intravitreal triamcinolone. A pilot study. Aust N Z J Ophthalmol 1995;23(4):293-8.
12. Danis RP, Ciulla TA, Pratt LM, Anliker W. Intravitreal triamcinolone acetonide in exudative age-related macular degeneration. Retina 2000;20(3):244-50.
13. Jonas JB, Kreissig I, Degenring R. Repeated intravitreal injections of triamcinolone acetonide as treatment of progressive exudative age-related macular degeneration. Graefes Arch Clin Exp Ophthalmol 2002;240(10):873-4.
14. Gillies MC, Simpson JM, Luo W, Penfold P, Hunyor AB, Chua W, *et al.* A randomized clinical trial of a single dose of intravitreal triamcinolone acetonide for neovascular age-related macular degeneration: One-year results. Arch Ophthalmol 2003;121(5):667-73.
15. Jonas JB, Akkoyun I, Budde WM, Kreissig I, Degenring RF. Intravitreal reinjection of triamcinolone for exudative age-related macular degeneration. Arch Ophthalmol 2004;122(2):218-22.
16. Jonas JB, Söfker A. Intravitreal triamcinolone acetonide for cataract surgery with iris neovascularization. J Cataract Refract Surg 2002;28(11):2040-1.
17. Jonas JB, Hayler JK, Söfker A, Panda-Jonas S. Regression of neovascular iris vessels by intravitreal injection of crystalline cortisone. J Glaucoma 2001;10(4):284-7.
18. Jonas JB, Hayler JK, Panda-Jonas S. Intravitreal injection of crystalline cortisone as treatment of pre-phthisical ocular hypotony. Graefes Arch Clin Exp Ophthalmol 2001;239(6):464-5.
19. Rodriguez ML, Juarez CP, Luna JD. Intravitreal triamcinolone acetonide injection in blind painful eyes. Intraocular steroids as a treatment for blind painful red eyes. Eur J Ophthalmol 2003;13(3):292-7.
20. McCuen BW 2nd, Bessler M, Tano Y, Chandler D, Machemer R. The lack of toxicity of intravitreally administered triamcinolone acetonide. Am J Ophthalmol 1981;91(6):785-8.
21. Gillies MC, Simpson JM, Billson FA, Luo W, Penfold P, Chua W, *et al.* Safety of an intravitreal injection of triamcinolone: Results from a randomized clinical trial. Arch Ophthalmol 2004;122(3):336-40.
22. Wingate RJ, Beaumont PE. Intravitreal triamcinolone and elevated intraocular pressure. Aust N Z J Ophthalmol 1999;27(6):431-2.
23. Moshfeghi DM, Kaiser PK, Scott IU, Sears JE, Benz M, Sinesterra JP, *et al.* Acute endophthalmitis following intravitreal triamcinolone acetonide injection. Am J Ophthalmol 2003;136(5):791-6.
24. Jager RD, Aiello LP, Patel SC, Cunningham ET Jr. Risks of intravitreous injection: A comprehensive review. Retina 2004;24(5):676-98.
25. Androudi S, Letko E, Meniconi M, Papadaki T, Ahmed M, Foster CS. Safety and efficacy of intravitreal triamcinolone acetonide for uveitic macular edema. Ocul Immunol Inflamm 2005;13(2-3):205-12.
26. Jonas JB, Degenring RF, Kreissig I, Akkoyun I, Kamppeter BA. Intraocular pressure elevation after intravitreal triamcinolone acetonide injection. Ophthalmology 2005;112(4):593-8.
27. Couch SM, Bakri SJ. Intravitreal triamcinolone for intraocular inflammation and associated macular edema. Clin Ophthalmol 2009;3:41-7.
28. Klein R, Klein BE, Moss SE. Visual impairment in diabetes. Ophthalmology 1984;91(1):1-9.
29. Sharareh B, Gallemore R, Taban M, Onishi S, Wallsh J. Recalcitrant macular edema after intravitreal bevacizumab is responsive to an intravitreal dexamethasone implant in retinal vein occlusion. Retina 2013;33(6):1227-31.
30. Barnes PJ. Anti-inflammatory actions of glucocorticoids: Molecular mechanisms. Clin Sci (Lond) 1998;94(6):557-72.
31. Jonas JB, Kreissig I, Hugger P, Sauder G, Panda-Jonas S, Degenring R. Intravitreal triamcinolone acetonide for exudative age related macular degeneration. Br J Ophthalmol 2003;87(4):462-8.
32. Wilson CA, Berkowitz BA, Sato Y, Ando N, Handa JT, de Juan E Jr. Treatment with intravitreal steroid reduces blood-retinal barrier breakdown due to retinal photocoagulation. Arch Ophthalmol 1992;110(8):1155-9.
33. Nauck M, Karakiulakis G, Perruchoud AP, Papakonstantinou E, Roth M. Corticosteroids inhibit the expression of the vascular endothelial growth factor gene in human vascular smooth muscle cells. Eur J Pharmacol 1998;341(2-3):309-15.
34. Penfold PL, Wen L, Madigan MC, Gillies MC, King NJ, Provis JM. Triamcinolone acetonide modulates permeability and intercellular adhesion molecule-1 (ICAM-1) expression of the ECV304 cell line: Implications for macular degeneration. Clin Exp Immunol 2000;121(3):458-65.
35. Floman N, Zor U. Mechanism of steroid action in ocular inflammation: Inhibition of prostaglandin production. Invest Ophthalmol Vis Sci 1977;16(1):69-73.
36. Lewis GD, Campbell WB, Johnson AR. Inhibition of prostaglandin synthesis by glucocorticoids in human endothelial cells. Endocrinology 1986;119(1):62-9.
37. Couch SM, Bakri SJ. Use of triamcinolone during vitrectomy surgery to visualize membranes and vitreous. Clin Ophthalmol 2008;2(4):891-6.
38. Vedantham V, Kim R. Intravitreal injection of triamcinolone acetonide for diabetic macular edema: Principles and practice. Indian J Ophthalmol 2006;54(2):133-7.
39. Pickrell A, Harris A, Ngo S, Amireskandari A, Stewart E, Siesky B. Delivery of intraocular triamcinolone acetonide in the treatment of macular edema. Pharmaceutics 2012;4(1):230-42.
40. Jonas JB, Hayler JK, Panda-Jonas S. Intravitreal injection of crystalline cortisone as adjunctive treatment of proliferative vitreoretinopathy. Br J Ophthalmol 2000;84(9):1064-7.
41. Jonas JB, Kreissig I, Kamppeter B, Degenring RF. Intravitreal triamcinolone acetonide for the treatment of intraocular edematous and neovascular diseases. Ophthalmologe 2004;101(2):113-20.
42. 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(5):598-604.
43. 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(4):205-9.
44. Jonas JB, Spandau UH, Harder B, Vossmerbaeumer U, Kamppeter BA. Inter-eye difference in exudative age-related macular degeneration with minimally classic or occult subfoveal neovascularization after unilateral intravitreal injection of triamcinolone acetonide. Am J Ophthalmol 2005;139(6):1073-9.
45. Smithen LM, Ober MD, Maranan L, Spaide RF. Intravitreal triamcinolone acetonide and intraocular pressure. Am J Ophthalmol 2004;138(5):740-3.
46. Park HY, Yi K, Kim HK. Intraocular pressure elevation after intravitreal triamcinolone acetonide injection. Korean J Ophthalmol 2005;19(2):122-7.