Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Subconjunctival Injection of Triamcinolone Acetonide for the Management of Pseudophakic Cystoid Macular Edema

Xinshu Liu
The Fourth People's Hospital of Shenyang, China Medical University
Shuling Wang
Shenyang Pharmaceutical University
Hao Zhang
laozhang678678@sina.com

The Fourth People's Hospital of Shenyang, China Medical University

Research Article

Keywords: triamcinolone acetonide, subconjunctival injection, pseudophakic cystoid macular edema

Posted Date: November 3rd, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11326652/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background

To evaluate the efficacy and safety of a subconjunctival injection of 10 mg triamcinolone acetonide (TA) for the treatment of PCME.

Methods

This retrospective observational case series study included treatment-naïve patients with PCME who received a subconjunctival injection of 10 mg TA. Optical coherence tomography (OCT) measurements, best corrected visual acuity (BCVA; logMAR) and intraocular pressure (IOP) were recorded.

Results

The study included 16 PCME patients with an average age of 65.4 ± 5.8 years. In the study population, 14 patients received a single injection, and 2 patients received a second injection at the 2-month follow-up. At the 3-month follow-up, complete resolution of central macular edema was achieved in 93.8% (15/16) of the eyes, and 62.5% (10/16) of the eyes gained a visual acuity of 0.2 logMAR or more. The baseline central macular thickness decreased from 506 (429, 688) μm to 288 (280, 320) μm (3 months, $p < 0.001$). BCVA increased from 0.35 (0.20, 0.50) to 0.05 (0.00, 0.10) (3 months, $p < 0.001$). The mean IOP increased from 13.2 ± 3.5 to 14.5 ± 2.6 mmHg (3 months, $p = 0.39$). After the surgical excision of the steroid depot, the elevated IOP returned to a normal IOP in 6.3% (1/16) of the eyes.

Conclusion

Subconjunctival injection of TA is an effective and safe treatment for PCME.

Introduction

Pseudophakic cystoid macular edema (PCME) is the most common cause of decreased visual acuity after uneventful cataract surgery [1]. Following cataract surgery, 1–2% of patients develop PCME accompanied by visual impairment; however, the proportion of asymptomatic PCME cases discovered through fluorescence fundus angiography and optical coherence tomography (OCT) can range from 30% to 40% [2, 3]. PCME may resolve spontaneously in most cases; however, in 1–3% of eyes, PCME necessitates treatment, and even in fewer cases, it may be refractory [4]. The precise pathogenesis of PCME remains unclear and is likely multifactorial. Inflammation, vascular instability, vitreomacular traction, ocular hypotony, and ultraviolet light damage during surgery together may contribute to the hyperpermeability of the perifoveal capillaries, resulting in fluid accumulation in the retina [5, 6].

At present, no evidence-based guidelines exist for the management of PCME. Common medical treatment strategies include topical nonsteroidal anti-inflammatory agents, local steroids, and systemic carbonic anhydrase inhibitors [1]. Novel applications of anti-vascular endothelial growth factor and subthreshold micropulse lasers are also promising [1]. Moreover, patients with chronic refractory PCME may benefit from surgical methods, such as the use of a Nd:YAG laser for anterior vitreolysis and pars plana vitrectomy [6]. Triamcinolone acetonide (TA) is a moderate-strength corticosteroid with a relatively long duration of anti-inflammatory effects [7]. Periocular or intravitreal TA is used for chronic PCME; however, significant side effects such as glaucoma have been reported [8]. The subconjunctival use of TA has been proven to be particularly safe and effective in some ocular inflammatory diseases [9, 10]. This study evaluated the efficacy and safety of the subconjunctival injection of TA for the treatment of PCME on the basis of real-life experience.

Patients and Methods

This retrospective observational study was approved by the Ethics Committee of The Fourth People's Hospital of Shenyang and was performed in accordance with the Declaration of Helsinki. PCME outpatients treated at the Department of Ophthalmology of The Fourth People's Hospital of Shenyang from October 2022 to July 2025 were enrolled into this study. Patients who met the following criteria were included: uncomplicated and uneventful phacoemulsification and capsular bag lens implantation surgery within the past 6 months, patient complaints of blurred vision and cystoid macular edema (CME) that was then confirmed through OCT, and treatment-naïve patients with a minimum follow-up of 3 months. The exclusion criteria were as follows: any ocular disease that could lead to decreased visual acuity (retinal vein occlusion, epiretinal membrane, macular degeneration, etc.), a history of vitrectomy, and a history of glaucoma or intraocular pressure (IOP) > 21 mmHg.

The subconjunctival injection of TA was prescribed for PCME patients. The eye was anesthetized with 0.5% topical proparacaine hydrochloride and prepared with 5% povidone-iodine. 10 mg/0.25 mL TA (Kunming Jida Pharmaceutical Co., Ltd., China; concentration: 40 mg/mL) was mixed with 0.2 mL of 2% lidocaine and then injected subconjunctivally at the inferior fornix with a 1-mL syringe.

Patients were examined and followed up in the 2nd week after injection and then every 4 weeks for at least 3 months, with additional follow-up visits whenever necessary. At each visit, a complete set of ophthalmic evaluations were performed, including best corrected visual acuity (BCVA) measurement; IOP recording; slit-lamp examination of the cornea, anterior chamber, intraocular lens, and vitreous; and fundus examination using an indirect ophthalmoscope. Optical coherence tomography (OCT) was performed before injection and every 4 weeks after injection.

IOP was measured using the noncontact tonometer (NT-510; NIDEK Co., Ltd., Japan). OCT was conducted by an experienced operator with the OCT device (VG200C; Intalight Imaging, Inc., China). Central macular thickness (CMT) was obtained by calculating the average retinal thickness of a 1-mm diameter disc centered on the fovea.

The following data were collected for analysis: sex; age at injection; interval between CME and cataract surgery; course of CME at injection; and CMT, BCVA, and IOP at each visit. Significant improvement in CME was defined as a decrease of 20% or more in CMT or no intraretinal or subretinal fluid detected through OCT. The complete resolution of CME was defined as no intraretinal or subretinal fluid detected through OCT.

Statistical analyses were performed using SPSS for Windows (v. 23.0, SPSS Inc.). Snellen visual acuity was converted into the logarithm of the minimum angle of resolution (log MAR), as described previously [11]. The normality of each variable was determined using the Shapiro–Wilk test. For variables with normal distributions, data were expressed as mean ± standard deviation, and repeated measures analysis of covariance was applied for within-group analysis. For variables with a non-normal distribution, data were expressed as median with interquartile range, and the Friedman test was employed for within-group analysis. A post hoc test with Bonferroni correction was used to evaluate pairwise differences. P values < 0.05 were considered to indicate statistical significance.

Results

A total of 16 patients (eyes) were included in this study. Among the 16 patients, 37.5% (6/16) were male, and 62.5% (10/16) were female, and their mean age at injection was 65.4 ± 5.8 years. The median interval between CME and cataract surgery was 2 months (interquartile range: 1 month to 2.9 months). The mean course of CME was 1.4 ± 1.0 months. All patients were treatment-naïve. The basic demographic and clinical characteristics of PCME patients are presented in Table 1.

Table 1
Basic Demographic and Clinical Characteristics of Patients.

Number of patients (eyes)	**16**
Male percentage	37.5%
Age (years)	65.4 ± 5.8
Interval between CME and cataract surgery (months)	2 (1, 2.9)
Course of CME (months)	1.4 ± 1.0
CME = cystoid macular edema	

All 16 eyes received a subconjunctival injection of 10 mg TA. At the 1-month follow-up, significant improvement and complete resolution of CME were observed in 93.8% (15/16) and 50.0% (8/16) of the eyes, respectively. In total, 12.5% (2/16) of the eyes received a second injection of 10 mg TA at the 2-month follow-up because of persistent intraretinal fluid. At the 3-month follow-up, complete resolution of CME was achieved in 93.8% (15/16) of the eyes, with only one eye having small intraretinal cysts left. The OCT data of a patient with PCME successfully treated with a subconjunctival injection of 10 mg TA are shown in Fig. 1.

BCVA improved in 87.5% (14/16) of the eyes at the 1-month follow-up, and the proportion of the eyes with an improvement increased to 100% (16/16) at the 3-month follow-up. At the 1-month follow-up, 50.0% (8/16) of the eyes gained a visual acuity of 0.2 logMAR or more, and the proportion of the eyes with the improvement increased to 62.5% (10/16) at the 3-month follow-up. None of the eyes had vision loss.

None of the eyes had IOP > 21 mmHg during the 3-month follow-up period. However, at the 3.5-month follow-up, 12.5% (2/16) of the eyes had IOPs exceeding 21 mmHg. One patient was a 73-year-old male with a single subconjunctival injection of 10 mg TA whose IOP was 25 mmHg. After observation for 2 weeks, his IOP returned to normal. The other patient was a 68-year-old female with a single subconjunctival injection of 10 mg TA whose IOP increased to 35 mmHg (increase of > 10 mmHg). Her IOP returned to normal after the surgical excision of the subconjunctival TA depot.

A total of 14 eyes that received a single subconjunctival injection of 10 mg TA were included in further statistical analysis. Compared with the preinjective baseline, a significant decrease in CMT was observed 1 month after injection ($p = 0.01$), followed by a further slight decrease at 3 months ($p < 0.001$). Similarly, a significant improvement in BCVA was observed 1 month after injection ($p = 0.03$), followed by a further slight improvement at 3 months ($p < 0.001$). A significant increase in IOP was noted at 1 month after injection ($p = 0.04$), followed by a slight decline at 3 months. However, the difference was not statistically significant compared with the preinjective baseline ($p = 0.39$) or with that at 1 month after injection ($p = 0.55$). The detailed information is presented in Table 2.

Table 2
Preinjective and Postinjective Central Macular Thickness, Corrected Distance Visual Acuity, and Intraocular Pressure.

CMT (μm)	**Preinjection**	**1 m after injection**	**3 m after injection**	**P**
	506 (429, 688) [a]	**312 (288, 361) [b]**	**288 (280, 320) [b]**	**< 0.001[$]**
CDVA (logMAR)	0.35 (0.20, 0.50) [a]	0.13 (0.10, 0.20) [b]	0.05 (0.00, 0.10) [b]	**< 0.001[$]**
IOP (mmHg)	13.2 ± 3.5 [a]	15.2 ± 3.6 [b]	14.5 ± 2.6 [a, b]	**0.02[&]**
CMT = central macular thickness; CDVA = corrected distance visual acuity; logMAR = logarithm of the minimum angle of resolution; IOP = intraocular pressure.				
"P[$]" is based on Friedman test, and "P[&]" is based on repeated measures analysis of covariance.				
"[a, b]": A post hoc test with Bonferroni's correction was used to evaluate the differences pairwise. Different letters indicate significant differences from one time point to the other.				

Discussion

Our study revealed that eyes with PCME treated with a subconjunctival injection of 10 mg TA had improvements in CME and visual acuity, with controllable IOP. Most of the treatment-naïve PCME eyes

responded quickly to a single subconjunctival injection of 10 mg TA, with complete resolution of macular edema and improvement in visual acuity within 3 months of follow-up. A few eyes with PCME that received repeated subconjunctival injections of 10 mg TA had further improvements in CME and visual acuity.

Corticosteroids exert extensive and powerful anti-inflammatory effects. Local corticosteroids are the mainstay in PCME treatment given that ocular inflammation is generally regarded as the predominant pathogenic pathway [12]. TA is a moderate-strength corticosteroid with a relatively long duration of anti-inflammatory effects. In a pharmacokinetic study of TA, Beer et al. found that after an intravitreal injection of 4 mg TA for macular edema in nonvitrectomized eyes, the mean elimination half-life was 18.6 days; this half-life suggested that TA remains present at measurable concentrations for approximately 3 months [13]. In our study, improvements in CME and visual acuity were still observed at the 3-month follow-up after a subconjunctival injection of 10 mg TA.

The subconjunctival injection of TA has been proven effective and safe for treating anterior segment inflammation [9]. Recently, our research showed that the subconjunctival injection of TA was also effective and safe for treating uveitic macular edema [14]. Shorstein et al. compared the effectiveness and safety of a single injection of subconjunctival TA to postoperative topical prednisolone acetate in inflammation prophylaxis after phacoemulsification cataract surgery [15]. Their results revealed that compared with topical treatment, an average dose of 4 mg TA was associated with a lower risk of postoperative macular edema and a similar risk of glaucoma-related events [15]. Based on animal studies, three theories have been proposed to explain how subconjunctivally injected corticosteroids enter the eye [16]: Directly through the sclera, through the blood stream, or via the tear film through the cornea. However, owing to the lipophilic barrier of the corneal epithelial layer, water-soluble formulations do not penetrate the cornea easily. Once in the eye, a fourth route of drug diffusion has been proposed: from the aqueous into the vitreous [17].

In the current study, we achieved a relatively high anatomical success rate (93.8%) with the subconjunctival injection of 10 mg TA for PCME treatment. We believe that the excellent outcome may be attributed to the baseline clinical characteristics of our study population. We included only treatment-naïve patients who underwent uneventful phacoemulsification surgery, and patients with other ocular diseases, such as epiretinal membranes, were excluded. In addition, the mean duration of CME was short (1.4 ± 1.0 months). In research on treatment-naïve PCME patients, Erden et al. also revealed a high anatomical success rate (90%) with a single injection of 40 mg triamcinolone via a blunt tip subtenon cannula through an inferonasal peritomy [18]. The intravitreal injection of TA is mostly applied in chronic/refractory PCME. Conway et al. found that an intravitreal injection of 1 mg TA was effective in 8 refractory PCME eyes with complex background diseases (epiretinal membrane, dry age-related macular degeneration, etc.), with 2 eyes requiring topical ocular antihypertensives and all eyes requiring repeated injections [19]. In a later study, Boscia et al. confirmed the efficacy of the intravitreal injection of 4 mg TA for the treatment of refractory PCME; however, four eyes (57.1%) developed IOP > 21 mmHg, and two patients experienced an endophthalmitis-like reaction [20]. Compared with subconjunctival injections,

intravitreal injections of TA may be associated with a higher rate of increased IOP and intraocular injection complications such as vitreous hemorrhage, endophthalmitis, and endophthalmitis-like reactions. Suprachoroidal injection is another administration route of TA. Oli et al. reported that the suprachoroidal injection of 4 mg TA for 3 eyes with chronic PCME was effective and safe when a self-modified 26-G needle was used [21]. However, the suprachoroidal injection of TA has been applied in only a few PCME eyes because of the nonavailability of the specialized microneedle used for injections. Furthermore, compared with other administration routes, the subconjunctival injection of TA is the simplest and most practical method, in which the procedure can be performed by experienced nurses in the office setting. Moreover, the postinjective subconjunctival steroid depot can be easily visualized. The surgical excision of the steroid depot is effective and safe for the management of postinjective elevated IOP [9]. The only eye with an elevated postinjective IOP that required treatment in our study had a normal IOP after the surgical excision of the steroid depot.

Sustained-release intraocular corticosteroid implants are also used for the treatment of chronic PCME, with the advantage of prolonged duration of action. Deaner et al. found that eyes with chronic PCME that were treated with the 0.18-mg fluocinolone acetonide insert had improved and sustained visual acuity and optical coherence tomography metrics [22]. However, the high cost is a major limiting factor.

Our study has several limitations. This was a small case series without a control group, and the results should be explored and validated in further studies. The follow-up period was also short. Although a high anatomical success rate was observed at the 3-month posttreatment interval, longer follow-up is needed to establish the retreatment criteria. Refractory or chronic PCME patients were not included in our study, and the efficacy and safety of the subconjunctival injection of TA in these patients should be further validated.

In conclusion, the subconjunctival injection of TA may be an effective and safe treatment modality for treatment-naïve PCME patients. This treatment involves a simple and practical procedure compared with the other administration routes of TA. Moreover, TA has a marked financial advantage over alternative drugs because of its low price. Increased IOP is a concern, but it can be well-controlled by the surgical removal of the TA depot, when necessary.

List of abbreviations

PCME pseudophakic cystoid macular edema

TA triamcinolone acetonide

OCT optical coherence tomography

BCVA best corrected visual acuity

IOP intraocular pressure

CME cystoid macular edema

CMT central macular thickness

Declarations

Ethics approval and consent to participate: This retrospective study was conducted in accordance with the tenets of the Declaration of Helsinki and was approved by the Ethics Committee of The Fourth People's Hospital of Shenyang. Informed consent was waived owing to the retrospective nature of the study.

Consent for publication: Not applicable.

Availability of data and materials: The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare no competing interests.

Funding: This work was supported by China Health Promotion Foundation [2025-ZCXY-0394].

Authors' contributions: LXS was responsible for study conception and design, data acquisition, data analysis, and drafting of the manuscript. WSL participated in the interpretation of results. ZH served as the corresponding author and provided overall supervision, contributing to study design, data analysis, interpretation, and manuscript preparation. All authors reviewed the manuscript.

Acknowledgements: None.

References

1. Orski M, Gawęcki M. Current management options in Irvine–Gass syndrome: a systemized review. J CLIN MED. 2021;10(19):4375.
2. Sigler EJ, Randolph JC, Kiernan DF. Longitudinal analysis of the structural pattern of pseudophakic cystoid macular edema using multimodal imaging. Graefe's Archive Clin Experimental Ophthalmol. 2016;254(1):43–51.
3. Grzybowski A, Kanclerz P. The role of steroids and NSAIDs in prevention and treatment of postsurgical cystoid macular edema. CURR PHARM Des. 2018;24(41):4896–902.
4. Kuley B, Storey PP, Wibbelsman TD, Pancholy M, Zhang QE, Sharpe J, et al. Resolution of pseudophakic cystoid macular edema: 2 mg intravitreal triamcinolone acetonide versus 40 mg posterior sub-tenon triamcinolone acetonide. CURR EYE RES. 2021;46(6):824–30.
5. Gonzalez-De LRA, Navarro-Partida J, Altamirano-Vallejo JC, Hernandez-Gamez AG, Garcia-Bañuelos JJ, Armendariz-Borunda J, et al. Novel triamcinolone acetonide-loaded liposomes topical

formulation for the treatment of cystoid macular edema after cataract surgery: a pilot study. J OCUL PHARMACOL TH. 2019;35(2):106–15.

6. Shelsta HN, Jampol LM. Pharmacologic therapy of pseudophakic cystoid macular edema: 2010 update. RETINA-J RET VIT DIS. 2011;31(1):4–12.
7. Frey H, Norman N. Duration of action of depot-corticosteroids. II. Triamcinolone acetonide and triamcinolone diacetate. EUR J CLIN PHARMACOL. 1971;3(4):229–31.
8. Han JV, Patel DV, Squirrell D, McGhee CN. Cystoid macular oedema following cataract surgery: A review. CLIN EXP OPHTHALMOL. 2019;47(3):346–56.
9. Athanasiadis Y, Tsatsos M, Sharma A, Hossain P. Subconjunctival triamcinolone acetonide in the management of ocular inflammatory disease. J OCUL PHARMACOL TH. 2013;29(6):516–22.
10. Liu X, Wang M, Zhao C, Gao F, Zhang M. The efficacy and safety of subconjunctival triamcinolone acetonide injections in treatment of uveitic macular edema. Zhonghua Yan Ke Za Zhi. 2015;51(10):734–38.
11. Holladay JT. Proper method for calculating average visual acuity. Journal of refractive surgery (Thorofare, N.J.: 1995) 1997, 13(4):388 – 91.
12. Campos A, Mota C, Cruz H, Sousa JP. Pseudophakic macular edema: Review and new insights on treatment and prophylaxis. SURV OPHTHALMOL. 2026;71(3):817–26.
13. Beer PM, Bakri SJ, Singh RJ, Liu W, Peters GB, Miller M. Intraocular concentration and pharmacokinetics of triamcinolone acetonide after a single intravitreal injection. Ophthalmology. 2003;110(4):681–86.
14. Qu Y, Liu X, Liang A, Xiao J, Zhao C, Gao F, et al. Subconjunctival injections of triamcinolone acetonide to treat uveitic macular edema. INT J OPHTHALMOL-CHI. 2020;13(7):1087–91.
15. Shorstein NH, McCabe SE, Alavi M, Kwan ML, Chandra NS. Triamcinolone acetonide subconjunctival injection as stand-alone inflammation prophylaxis after phacoemulsification cataract surgery. Ophthalmology. 2024;131(10):1145–56.
16. Gaudio P. A review of evidence guiding the use of corticosteroids in the treatment of intraocular inflammation. OCUL IMMUNOL INFLAMM. 2009;12(3):169–92.
17. Weijtens O, Feron EJ, Schoemaker RC, Cohen AF, Lentjes EG, Romijn FP, et al. High concentration of dexamethasone in aqueous and vitreous after subconjunctival injection. AM J OPHTHALMOL. 1999;128(2):192–7.
18. Erden B, Çakır A, Aslan AC, Bölükbaşı S, Elçioğlu MN. The efficacy of posterior subtenon triamcinolone acetonide injection in treatment of Irvine-Gass syndrome. OCUL IMMUNOL INFLAMM. 2019;27(8):1235–41.
19. Conway MD, Canakis C, Livir-Rallatos C, Peyman GA. Intravitreal triamcinolone acetonide for refractory chronic pseudophakic cystoid macular edema. J CATARACT REFR SURG. 2003;29(1):27–33.

20. Boscia F, Furino C, Dammacco R, Ferreri P, Sborgia L, Sborgia C. Intravitreal triamcinolone acetonide in refractory pseudophakic cystoid macular edema: functional and anatomic results. EUR J OPHTHALMOL. 2005;15(1):89–95.
21. Oli A, Waikar S. Modified inexpensive needle for suprachoroidal triamcinolone acetonide injections in pseudophakic cystoid macular edema. INDIAN J OPHTHALMOL. 2021;69(3):765–7.
22. Deaner JD, Mammo D, Gross A, Lee T, Sharma S, Srivastava SK, et al. 0.18mg fluocinolone acetonide insert for the treatment of chronic postoperative pseudophakic cystoid macular edema. RETINA-J RET VIT DIS. 2023;43(6):897–904.

Figures

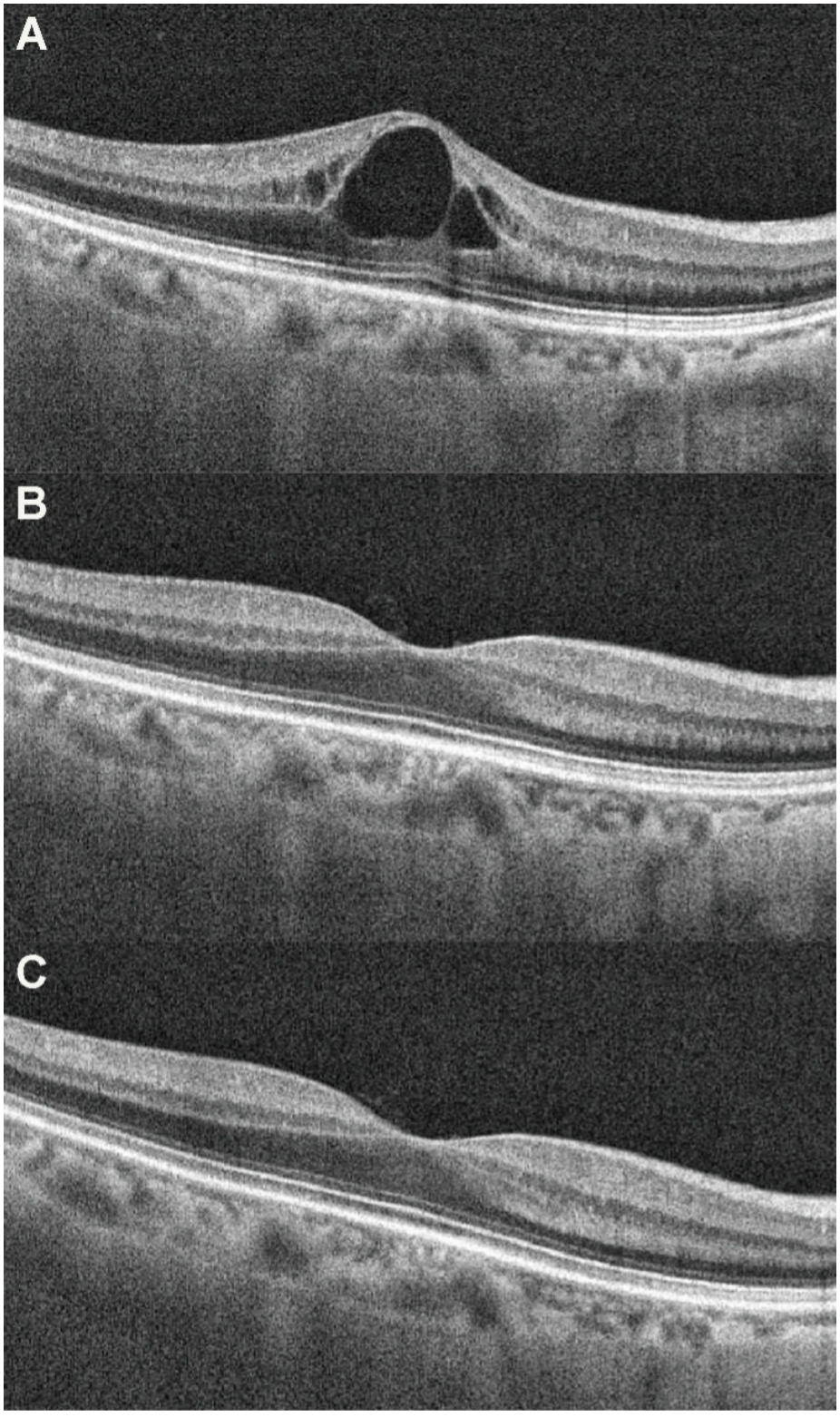


Figure 1

Optical coherence tomography of the right macula: showing the complete resolution of pseudophakic cystoid macular edema after the subconjunctival injection of 10 mg triamcinolone acetonide: (A) preinjection; (B) 1 month after injection; (C) 3 months after injection.