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Safety and efficacy of suprachoroidal triamcinolone acetonide for the management of serous choroidal detachment prior to rhegmatogenous retinal detachment surgery: A Pilot study

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Purpose: To study the safety and efficacy of pre-operative suprachoroidal triamcinolone acetonide (SCTA) for achieving reduction/resolution of serous choroidal detachment (CD) associated with rhegmatogenous retinal detachment (RRD). **Methods:** This was a prospective, noncomparative, interventional pilot study. All consecutive patients presenting with RD and coexisting CD underwent transconjunctival injection of SCTA before proceeding with vitrectomy/scleral buckle surgery. Sequential ultrasound B scans were performed for assessing the change in height of the CD. **Results:** The mean age of the cohort was 53.8 ± 10.8 years (range: 39–72 years). The CD was present in a median of 3 quadrants; the cumulative mean CD height was 5.59 mm (range: 2.02–9.42 mm). Following SCTA, a successful response (>50% reduction) was seen in five eyes by day 3 and in two eyes by day 5. Three eyes failed to respond to SCTA and required surgical drainage before proceeding with vitrectomy. No intraprocedural injection-related complications were noted. A transient rise in the intraocular pressure (30 mmHg) was seen in one eye following vitrectomy and was managed successfully with topical antiglaucoma medications. **Conclusion:** Suprachoroidal administration of triamcinolone appears to be a safe and effective technique to achieve CD resolution in eyes with RRD.

Key words: Choroidal detachment, needle, retinal detachment, suprachoroidal, triamcinolone acetonide

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The management of rhegmatogenous retinal detachment (RRD) can be complicated by the presence of a coexisting choroidal detachment (CD). The incidence of CD in eyes with RRD has been estimated to range between 2%–18%.[1] The management of RD in the presence of CD is not only challenging but also fraught with a greater risk of surgical failure (30%–40%) compared to uncomplicated retinal detachments.[2-4]

The use of systemic steroids in the preoperative period has been suggested to improve the anatomical outcomes of pars plana vitrectomy (PPV) in these eyes by reducing the inflammatory exudation, promoting suprachoroidal fluid resolution, and reduction of proliferative vitreoretinopathy (PVR) progression. The use of systemic steroids may not always be feasible and safe in patients with systemic comorbidities like uncontrolled diabetes and hypertension. Periocular/intravitreal steroids can therefore serve as an effective and useful alternative to systemic steroids for the management of this condition.

Periocular steroid preparations may not be consistently effective due to their ambivalent drug absorption/bioavailability and the associated risk of inadvertent globe perforation. The use of intravitreal steroids also harbor the risks of inducing a marked increase in intraocular pressure (IOP) and cataractogenesis that tend to limit their regular usage.[5] Besides the aforementioned side effects, the intravitreal route of delivery has an increased likelihood of incurring iatrogenic injury to the lens or the retina, especially in eyes with massive choroidal detachments. Furthermore, the intravitreal route of drug delivery carries an additional risk of endophthalmitis.[6]

Surgeons have attempted to circumvent the potential risks involved with periocular and intravitreal depot steroid preparations by utilizing the suprachoroidal space for the treatment of inflammatory macular edema and noninfectious posterior uveitis.[7] The inherent potential of the suprachoroidal space to expand and its proximity to the choroid permits the injected drug to achieve higher tissue bioavailability for a longer time.[8-10] The continuity of the suprachoroidal space, extending from the scleral spur to the optic nerve head, ensures adequate drug distribution, while the restriction to spread beyond the scleral spur lowers the risk of incurring an IOP spike. Furthermore, endophthalmitis following the use of suprachoroidal injections has not been documented so far.

The development of thinner and shorter needles with guards for suprachoroidal administration has further improved the

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user-friendliness and safety profile of suprachoroidal injections and has increased their popularity over the past few years.[6]

The safety and efficacy of suprachoroidal steroids prior to retinal detachment surgery for managing eyes with CD-RD have not been evaluated so far. We, therefore, evaluated the sequential change in CD height following administration of suprachoroidal triamcinolone acetonide (SCTA) in patients with associated RRD in the present study. Considering that the development of CD occurs after inflammation, with hyperpermeability of the choroidal vasculature,[2,11] we hypothesize that injection of triamcinolone into the suprachoroidal space could be an effective technique for achieving resolution of the CD, without causing any major ocular or systemic complications.

Methods

This was a single-center, prospective, noncomparative, interventional pilot study to evaluate the efficacy of pre-operative SCTA for the management of CD associated with RD. The study participants were recruited after obtaining approval from the institutional review board. Patients were enrolled after explaining the available options. Informed consent was obtained in the patient's own language and the patients were explained regarding the injection procedural nuances and potential complications. The study adhered to the tenets of the Declaration of Helsinki.

All consecutive patients aged more than 18 years, presenting with RRD and coexisting CD between February 2018 and June 2019 were recruited to undergo preoperative SCTA injection followed by surgery for retinal detachment. Patients with a history of vitrectomy or scleral buckle, those with advanced glaucoma, uniocular patients, and those not willing for participation were not considered for recruitment. All patients completed a mean follow-up of three months.

The study data were collected and entered into an excel sheet as per the predefined proforma. Demographic details including age, gender, systemic history of diabetes or hypertension were recorded. Clinical details regarding the duration of symptoms, corrected distance visual acuity (CDVA), phakic status, IOP, presence of intraocular inflammation, the extent of RD, number and location of the break (s), choroidal detachment, and severity of PVR were noted. The CDVA was recorded using digital Snellen's charts and was converted to LogMAR for statistical analysis. Intraocular pressure was measured using Goldmann's applanation tonometry. The severity of PVR was graded as per the updated retina society classification.[12]

Detection and measurement of the CD were done using an ultrasound B Scan probe (12.5 MHz) by a single vitreoretinal surgeon (DH). The number of quadrants involved, the maximum height of the CD in millimeter, and its specific quadrant were noted. The measurements were done by using a longitudinal scan and inbuilt calipers. In the clock hour of maximum observable choroidal elevation on a longitudinal B scan, the caliper tool was used to draw a perpendicular line between the scleral spike on B scan and the maximum height of choroidal elevation; a mean of three readings was taken.

Suprachoroidal injection of preservative-free triamcinolone acetonide (Aurocort©, Aurolab, Madurai, India) (4 mg in 0.1 ml) was administered using an in-house, indigenously designed suprachoroidal needle [Fig. 1]. The suprachoroidal needle was made using commercially available 20 and 30 gauge (G) needles (Dispovan©, HMD, Delhi, India). The needle design comprised a central core of the 30G needle (12 mm) and outer housing of the 20G needle (20 mm), which was threaded onto the central core. The 30G needle was taken from a pre-packed, sterilized 2 ml plastic syringe pack and the 20G needle was procured from the sterile 10 ml plastic syringe pack. The 20G needle was cut to a length of 11 mm using artery forceps and its hub was disinserted, such as to allow a tip exposure of only 1 mm for the 30G needle when threaded into the 20G barrel. The outer guard was made under microscopic visualization and was sterilized before each suprachoroidal injection procedure, while a fresh 30G core needle was used for every case. The hub of this hybrid (20G/30G) needle complex was then mounted onto a 1 ml tuberculin syringe containing triamcinolone acetonide. The disinsertion of the 20G needle was done using artery forceps which led to clamping of the disinserted terminal thus converting the original rounded openings into slit-like openings. Hence, when the guard was inserted onto the 30G needle, the clamped ends enabled a snug fit of the 30G needle and prevented the guard from falling when the hub faced downwards.

The injection was performed transconjunctivally at a distance of 4 mm from the limbus in the temporal quadrant

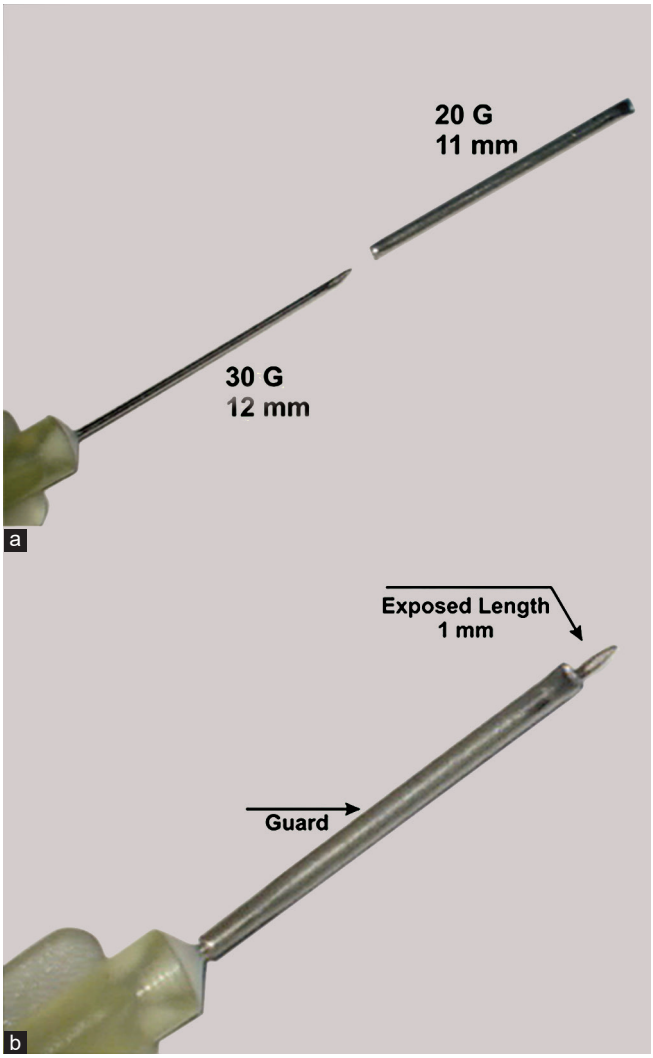

Figure 1: Photographic demonstration of preparing the suprachoroidal needle using the commercially available 20 and 30 gauge needles. The 12-mm 30 gauge needle was threaded into a disinserted 20 gauge needle cut to a length of 11 mm (a). The outer 20 gauge housing acts as a guard to allow a 1-mm exposure length of the 30 gauge needle core for injection (b)

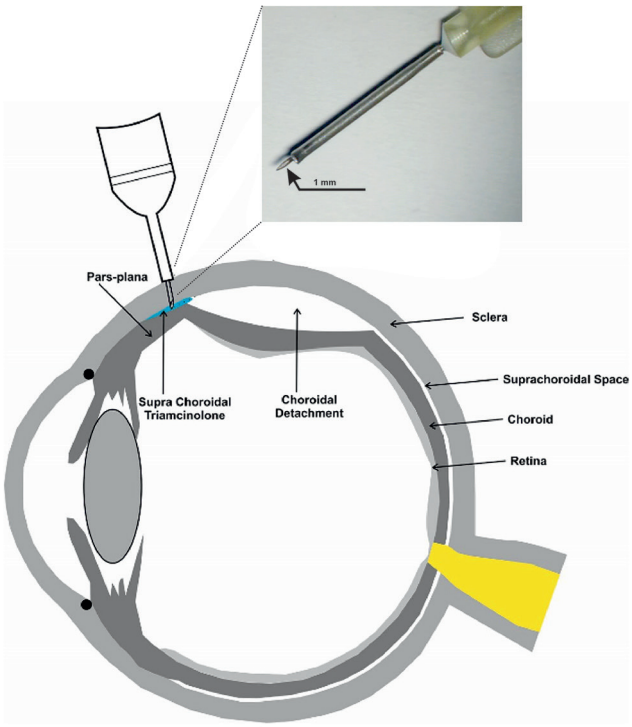

Figure 2: Image artwork shows the injection technique into the suprachoroidal space through the pars plana while the zoomed inset shows the 1 mm exposed needle tip adequate to transgress the sclera

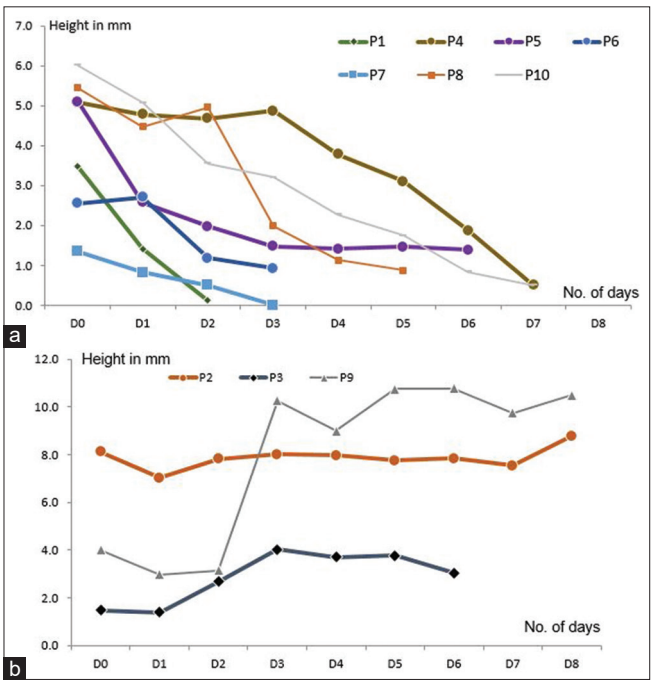

Figure 3: Graphical representation of the change in cumulative mean height (CMH) of the choroidal detachment over seven days in eyes who responded to SCTA injection (a). The change in CMH for the eyes that failed to show a successful response to SCTA is depicted in Graph (b)

above the horizontal meridian [Fig. 2]. The hybrid needle complex was held parallel to the floor till the injection site was in proximity; this was done to prevent degloving of the outer housing. The needle was then straightened perpendicular to the sclera near the site of injection. This manoeuver prevented the dripping of the triamcinolone suspension from the needle. The technique of injection required the needle to be inserted perpendicular to the scleral surface with the bevel facing away from the limbus to facilitate the posterior spread of the drug. The drug was injected while maintaining pressure on the hub after a tactile sensation of give-away was felt, indicating that the needle had traversed the sclera. The needle was maintained in position for 30 s after injection to prevent the reflux of the injected drug. Following the injection of SCTA, the patient was evaluated using indirect ophthalmoscopy for the presence of any iatrogenic retinal breaks or subretinal bleed.

Serial ultrasound B scans were performed daily to note the change in CD height in each quadrant and the time to its resolution in the post-injection period. The cumulative mean height (CMH) of CD for each eye was calculated by averaging out the maximum observable CD height for each quadrant. The CMH was used to represent the estimated volume/height occupied by the CD for each eye; this was done to better represent and compare the evolutionary changes during resolution. Success was defined as a reduction in CMH by ≥50% following the SCTA injection. Failure was defined as a reduction of CMH <50% or its increase following injection. In eyes showing a successful response, we considered CD to be resolved when the CMH decreased to less than 2 mm, while persistent CD was defined as CMH ≥2 mm.

The choice between scleral buckle or vitrectomy was taken after reevaluation of the patient following an initial observation period of 7 days or earlier if the CDs showed resolution (CMH < 2 mm). Scleral buckle surgery was done in phakic eyes with a single, peripheral break after the choroidal detachment had resolved. In eyes with multiple or unidentifiable breaks, pseudophakia, and the presence of proliferative vitreoretinopathy, vitrectomy was the primary surgical choice. Eyes showing CD resolution were taken up for surgery, while those not showing resolution were observed until day seven post SCTA injection before being taken up for surgery.

Eyes with persistent CDs even after seven days underwent a B scan to evaluate the location of the highest CD for performing surgical drainage before proceeding with vitrectomy. The CDs were drained below the preplaced band using a 26 G needle mounted on a 1 ml syringe after making the sclerotomies and securing the infusion cannula.

In the postoperative period, the patients were maintained on a monthly follow-up. At each visit, the patient was evaluated for CDVA, IOP, retinal status, and presence of PVR. Silicone oil removal (SOR) was performed after assessing the retinal reattachment status and laser retinopexy uptake. The primary outcome measures included the number of eyes achieving a reduction in CMH of CD by 50%, time taken to achieve this reduction, and ocular complications following SCTA. Secondary outcome included anatomical success defined as the number of eyes with an attached retina after surgery.

Statistical analysis

The Statistical analysis was performed by STATA 11.2 (College Station TX USA). The student's paired t-test was used to evaluate the pre and post-injection comparison of normally distributed numerical data like LogMAR visual acuity and IOP. Descriptive statistics were used for variables like age, gender, CD quadrants, highest CD height, the average duration of SOR, and axial length and were expressed as mean and standard

Table 1: Distribution of baseline characteristics for choroidal detachment, axial length, and intraocular pressure changes

	Mean	SD	Median	Range	*P*
CD Quadrants	2.9	0.99	3	1-4	-
Cumulative mean height (mm)	5.59	2.82	6.03	2.02-9.42	-
Axial Length (mm)	24.24	2.17	23.85	21-29.18	-
IOP (mmHg)					
Baseline	6.60	4.17	-	1-14	
1 week	9.0	8.48	-	3-15	0.655
1 month	14.38	2.67	-	10-38	0.025
Final	14.0	4.21	-	7-20	0.008

SD: Standard deviation; CD: Choroidal detachment; IOP: Intraocular pressure

deviation and frequency and percentage. A *P* value less than 0.05 was considered statistically significant.

Results

Ten eyes of ten patients with CD-RD were given preoperative SCTA before undergoing surgery. The study cohort consisted of 7 males (70%) and 3 females (30%). The mean age of the cohort was 53.8 ± 10.8 years (range: 39–72 years). The average duration of the diminution of vision was 18.5 ± 17.5 days (range: 2–60 days). The right eye was involved in 4 cases (40%) while the left eye was involved in 6 cases (60%). Hypertension was the only associated comorbidity present in 4 patients (40%).

On clinical examination, four eyes were phakic, 5 were pseudophakic, and 1 was aphakic; none of the eyes showed clinically detectable inflammation in the anterior segment. There were 6 eyes with total RD (4 quadrants) and 4 eyes showed subtotal RD (<4 quadrants); PVR-A was present in 7 eyes and 3 eyes had PVR-B with the macula being detached in all the eyes. The baseline CDVA was LogMAR 1.73 ± 0.78, which improved to LogMAR 1.13 ± 0.77 by the last follow-up ($P = 0.114$). The average follow-up of the study cohort was 7.7 months (range: 3–12 months).

The CD was present in all 4 quadrants in 3 eyes, 3 quadrants in 4 eyes, 2 quadrants in 2 eyes, and one quadrant in 1 eye. The highest CD was present in the temporal quadrant in 6 eyes, followed by the superior quadrant in 2 eyes and the inferior and nasal quadrant in 1 eye each. Details regarding the distribution of CD and their measurements with the axial length are detailed in Table 1.

Following SCTA, a successful response (>50% reduction in CMH) was seen in five eyes by day 3 and in two eyes by day 5 [Fig. 3a]. Three eyes failed to respond to SCTA, of which two developed an increase in the CMH, while in one eye the CD persisted with <10% change in CMH by day 7 [Fig. 3b]. None of the eyes showing a successful resolution required intraoperative drainage of the suprachoroidal fluid. The three eyes with persistent CDs required surgical drainage before proceeding with vitrectomy. Nine eyes underwent vitrectomy with a belt buckle and silicone oil tamponade and in one eye, a scleral buckle was performed. One eye developed raised IOP 30 days post PPV and was controlled with a single topical antiglaucoma medication alone. The IOP change in the cohort is detailed in Table 1.

A successful anatomical attachment was achieved in 9 eyes. One eye which failed to respond to SCTA developed redetachment under silicone oil for which surgery was deferred in anticipation of a poor visual outcome, and the remaining eight underwent SOR after 8 weeks. The average duration after which SOR was performed was 16.6 weeks (range: 11–32 weeks). None of the eyes developed recurrent detachment during silicone oil removal or following it.

Discussion

The time taken to achieve a favorable therapeutic response to steroids in eyes with CD in previous studies using systemic steroids has been estimated to range between 7–14 days.[13,14] In our series, the use of SCTA led to a reduction of 50% in the cumulative mean height of the CD occurred in 7 out of 10 eyes by day 5 depending upon the extent of CD at presentation. In a study evaluating the role of periocular and systemic steroids on the resolution of CD by Azad *et al.*,[13] the authors reported the reduction of CD in 12 out of 20 cases (60%). Similarly, in a study evaluating the efficacy of preoperative oral steroids by Denwattana and colleagues,[15] they observed a reduction in CD height in 18/39 eyes (46%) and resolution in 14/39 (36%) of the eyes.

In comparison to the above-mentioned reports evaluating only qualitative change in CD with systemic and periocular steroids, we observed a significant reduction in the height of CD by the second day following SCTA. A successful response to SCTA, i.e., reduction of >50% in the CMH from baseline, was observed in 70% of the patients by the fifth day; all these eyes achieved near-complete resolution within the first week itself and did not require surgical drainage of the choroidals. It is challenging to compare our results on the sequential change in CD with SCTA with the existing studies since most of the studies have qualitatively assessed CD resolution and not the time to achieve CD resolution.

Interestingly, a subset of eyes (3/10 eyes) in whom the CD persisted even after a week did not show successful response to SCTA by day 5 and these eyes eventually required surgical drainage of the choroidal before proceeding with vitrectomy. In our opinion, the inability to obtain a successful response in the above subset can be attributed either to a suboptimal dosage, possibility of drug regurgitation, attenuation of the efficacy due to dilution of the drug within the serous detachment, and the single site of injection (temporal quadrant) rather than injecting it in all quadrants. We specifically chose the temporal quadrant for injection, irrespective of the location of maximum CD height, considering that the temporal quadrant was easier to access and was relatively safe owing to a wider pars plana.

As the drug concentration achieved with both systemic as well as periocular steroids has been found to be four times lower in the posterior segment as compared to the anterior segment, the treatment response with these modalities may be variable and the resolution of CD can be delayed until two weeks.[13,16] The earlier response of CD resolution in the majority of our patients (70%) by the first week can be attributed to the higher redistribution of the drug in the posterior segment due to the suprachoroidal route of injection.

The pathogenesis of CD formation in eyes with RD involves accumulation of the choroidal transudate and expansion of the suprachoroidal space separating the underlying vascular choroid. This expansion of the potential suprachoroidal space favors the atraumatic administration of SCTA in these eyes by providing a greater safety margin. The presence of this fluid cushion above the vascular choroid decreases the chance of incurring iatrogenic bleeds due to inadvertent needle contact with the choroid. Also, the presence of a preexisting RD provides an additional safety net by minimizing the chances of the needle perforating the retina while injecting the drug.

Both these factors were taken into consideration while framing our hypothesis that SCTA administration in CD-RD was a potentially safe option and this was further proven by the absence of injection-related complications in our series. To further enhance the safety profile of SCTA, we ensured that the needle being used for injection had an exposure length of only 1 mm for which a safety hub was used to prevent its entry beyond the suprachoroidal space. Because the eyes with CDs are hypotonic, we did encounter difficulties in injection due to the soft globe. The use of 30G sharp needles, perpendicular insertion, and the use of a bud swab to apply pressure aided in the smooth insertion of the suprachoroidal needle.

In our series, the IOP progressively normalized after the SCTA administration. We believe that the rise in IOP can be attributed to the decrease in ciliary body inflammation with the closure of the alternate pathway for aqueous drainage, and not to a steroid response. The possibility of SCTA to cause a steroid response remains negligible considering that it remains in the suprachoroidal space only for a week due to its fast clearance.[17] This factor coupled with the lower concentration of the drug within the anterior chamber after SCTA injection decreases the propensity to cause a pressure spike.[17] The IOP rose significantly a month after the surgery (14.38 mmHg) compared to the presenting pressure (6.6 mmHg) but was most likely a consequence of surgical retinal reattachment.

Anatomical failure was found only in one eye, which had shown persistence of CD despite SCTA. In our opinion, SCTA does not affect the anatomical outcomes directly as the failure to achieve retinal attachment depends on a multitude of factors of which ocular inflammation is a participant. The role of SCTA is only limited to decreasing the risk of PVR due to persistent ocular inflammation and resolving the choroidal for an atraumatic surgery.

Although our project remains limited by a small sample population of ten eyes, it was essential for us to evaluate the results of this pilot study before administering SCTA in more eyes. The encouraging results of this pilot study have prompted us to continue injecting SCTA in eyes with CD-RD and we are in the process of conducting a study with a larger dataset. The change in CD in our series was estimated by using cumulative mean height and not the volume which the CD (s) occupied. The needle length used for administration of SCTA was the same for all the eyes regardless of the scleral thickness, which could have affected drug delivery to the desired plane. Though SCTA was found to be effective in achieving a favorable response in the majority, the absence of a comparative arm makes it difficult to establish its superiority over the existing routes of steroid administration. What remains to be further investigated is the need for titrating the dose of SCTA based on the CMH of the CD(s).

The prospective study design, standard injection technique, and daily ultrasound for monitoring the CDs strengthen our study. Besides, we have described the creation and usage of an indigenous needle design that can be safely used for SCTA administration in the eyes with combined CD-RD. To the best of our knowledge, the daily sequential change and time to resolution of CDs remain undescribed in literature. To our knowledge, our study is the first study to demonstrate the safety and utility of SCTA in CD-RD.

Conclusion

The results from our pilot study on the use of SCTA in CD-RD suggest that preoperative administration of single-site 4 mg/0.1 ml SCTA is effective in achieving CD resolution with no associated procedural or post-procedural complications. SCTA can be considered in eyes with CD-RD to achieve rapid resolution of serous choroidals.

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Conflicts of interest

There are no conflicts of interest.

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