

Diode laser trans-scleral cyclophoto-coagulation in the management of glaucoma in patients with long-term intravitreal silicone oil

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Abstract

Aims To analyse the results of contact trans-scleral cyclodiode photocoagulation (TSCPC) in reducing intraocular pressures (IOP) refractory to medical treatment in a group of patients with intravitreal silicone oil.

Methods The medical records of 18 patients who received TSCPC were evaluated retrospectively. Success was evaluated primarily in terms of IOP control. Success was defined as a final IOP of less than 22 mmHg

Results In all, 18 eyes of 18 patients were followed up for an average of 21.8 months (range 6–36) (SD = 8.6). The mean pre-treatment IOP was 39.6 mmHg (range 25–56 mmHg) (SD = 9.3). This reduced to 20.0 mmHg (range 0–48, SD = 13.5) after TSCPC, producing a mean reduction of 49% from mean pretreatment IOP levels. The overall success rate was 44% (eight eyes). Chronic hypotony occurred in two patients. IOP remained above that required to meet the IOP reduction criteria in eight patients.

Conclusion Our results raise doubts about the efficacy of TSCPC in the management of glaucoma in eyes retaining silicone oil. This may relate to the long duration of silicone oil in our patients. Further studies are required to identify risk factors for treatment failure.

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Introduction

The use of silicone oil has an established place in the management of retinal detachments complicated by proliferative vitreoretinopathy (PVR). However, chronically elevated intraocular pressure (IOP) is a common complication of such treatment. The preferred management for eyes with elevated IOP unresponsive to treatment is the removal of silicone oil. However, owing to complications such as redetachment of the retina, this may not be a viable option. Trans-scleral cyclodiode photocoagulation (TSCPC) has been demonstrated as a safe and effective method of treating intractable glaucoma in eyes retaining silicone oil.^{1–3} Below, we describe the effect on IOP of TSCPC based on the retrospective review of medical records of patients with intravitreal silicone oil and intractable glaucoma.

Methods

In all, 18 eyes of 18 patients with medically uncontrolled IOPs received TSCPC between January 1999 and December 2000. The patients were identified from an electronic patient record system, which allowed easy identification of all patients within a given time period. A retrospective review of their notes was then made.

The inclusion criteria were defined as an IOP greater than or equal to 25 mmHg on maximum tolerable medication on two or more consecutive follow-up visits in patients retaining intravitreal silicone oil. TSCPC was

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indicated for eyes considered too high risk for silicone oil removal.

The primary outcome measure was final IOP. Treatment was considered successful if the final IOP was less than 22 mmHg and could be maintained with or without medical treatment. Analysis of variance with repeated measures was used to assess the time effect on the IOP with measurements taken pretreatment and post-treatment after 2 weeks, 4 weeks, 6 weeks, 3 months and 6 months. The secondary outcome measure was the reduction in the use of ocular anti-hypertensive medication. To assess whether this reduction was significantly different from zero, we use a paired *t*-test and the mean reduction is estimated with a 95% confidence interval. In the same manner, we provide an estimation of the proportion of patients who suffered a decrease in vision. Treatment was considered a failure if the IOP reduction specified above could not be obtained, if chronic hypotony occurred (IOP less than or equal to 5 mmHg) and if the final vision was no -perception of light.

All patients were given a baseline slit-lamp examination, which included measurements of IOP and best-corrected Snellen visual acuity. Informed consent was then obtained and treatment commenced. Prior to treatment with TSCPC, the eyes were anaesthetised with g.Amethocaine and a peribulbar injection of 2.0–5.0 ml of lignocaine 2%. Laser energy was then applied to the ciliary body using a 600 µm diameter quartz fibre optic handpiece (OcuLight SLx, Iris Medical Instruments) held 1.2 mm behind the surgical limbus, with the fibre optic orientated approximately parallel to the visual axis. Anatomical markers were therefore used to identify the position of the ciliary body instead of transillumination. The probes were not re-used. During the first TSCPC for an enrolled eye, an average of 25 pulses of laser energy was spaced evenly to the inferior or superior 180° of the ciliary body. The initial power setting used was 1.5 W. This was increased to 2.0–2.5 W if there was no sound denoting tissue disruption (a ‘pop’ sound from within the eye). The power was reduced back to 1.5–1.75 W if a ‘pop’ sound was heard on two sequential, subsequent laser applications. The duration of the burns were set to 1.5 s. All patients then received topical steroid and mydriatic eye drops for a week. Prelaser antiglaucoma medications were continued postoperatively at the discretion of the treating ophthalmologist with the exception of miotics that were discontinued. Antiglaucoma medications were then adjusted according to IOP measurements on subsequent follow-up visits. Re-treatment with cyclodiode laser was performed if the IOP remained above 25 mmHg on two or more subsequent follow-up visits. If re-treatment was performed the previously untreated half of the ciliary body was treated.

Postoperatively, patients were initially reviewed at 2 and 6 weeks and then at 3–6-month intervals. At each follow-up visit, the IOP and best-corrected Snellen visual acuity were recorded. Slit-lamp biomicroscopic and fundal examinations were also performed.

Results

The mean total follow-up period after TSCPC was 21.8 months (range 6–36 months) (SD = 8.6). Of the 18 patients treated, 11 were women and seven were men. Their mean age was 63 years (range 36–85 years). The indications for silicone oil insertion were varied (see Table 1). The total PVR rate was 56% (10 eyes).

Pre-existing ocular comorbidity was a significant problem and was present in eight patients. This comprised five patients with glaucoma (primary open angle glaucoma (two), congenital glaucoma (one), rubeotic glaucoma (two)) and one with cytomegalovirus retinitis complicating human immunodeficiency virus infection with coexisting Wegener’s granulomatosis. One patient had chronic inflammation of unknown aetiology and another had sickle cell retinopathy. The mean number of operations that had been performed on the study eye prior to TSCPC was 2.9 (range 1–6). A total of 12 eyes were aphakic, four were pseudophakic, and two were phakic. Emulsified silicone oil was seen in the anterior chambers of three eyes.

The mean duration of oil before TSCPC was 33.7 months (range 1–113 months, SD = 26.9). Only three of the 18 eyes had silicone oil tamponade for less than 1 year (1, 1.5, and 6 months, respectively). Of these, two had rubeotic glaucoma and one had advanced primary open angle glaucoma. These factors warranted early surgical intervention. The mean laser energy used in our series was 92.0 J (SD = 40.6, range 45–180 J) with a mean number of laser treatment episodes of 1.6 (range 1–3). Our overall re-treatment rate was 50%.

The mean IOP prior to TSCPC was 39.6 mmHg (ranged 25–56 mmHg) (SD = 8.7). This had reduced to 20.0 mmHg (range 0–48 mmHg, SD = 13.5) after TSCPC at final follow-up. The mean reduction in IOP was by 19.6 mmHg, achieving a mean reduction of 49%.

Table 1 Reason for silicone oil insertion

Retinal pathology	Number of patients (n = 18)
Rheg RD	5
Rheg RD + PVR	10
Diabetic TRD	1
Sickle cell TRD	1
RD with complicating vasculitis	1

Rheg = rhegmatogenous; RD = retinal detachment; TRD = tractional retinal detachment.

Repeated measure analysis was performed on the 18 patients with the last measure at 36 months extrapolated from the individual time series. The overall significant time effect was significant ($P = 0.001$). *Post hoc* pairwise comparisons with Bonferroni adjustment point to a significant decrease in IOP very early after treatment (2 weeks). The level reached at 2 weeks was sustained until 15 months when a further reduction was observed. No significant additional changes in mean IOP are observed between 15 and 36 months.

The first time for the IOP to reach below the 22 mmHg mark, and sustained for at least 6 months, was analysed using the Kaplan–Meier method (Figure 1). Patients for whom the IOP did not go down to 21 mmHg by the end of the study were censored with the last examination time taken as their observed time. The Kaplan–Meier plot is presented below. The mean time spent with IOP above 21 mmHg was 668 days (95% CI 455–881 days). 53% (SE = 12%) of the patients took 450 days to reduce the IOP below 21 mmHg. For 72% (SE = 11%) of the patients the time spanned before they reached 21 mmHg in IOP was 215 days.

At final follow-up, 10 patients (56%) were classified as treatment failure. Of these, two patients developed chronic hypotony. Eight patients had IOPs above 22 mmHg, of which, two had final visual acuities of NPL. Therefore, eight patients (44%) were classified as success with final IOPs of less than 22 mmHg. When the eight patients with ocular co-morbidity were excluded from the calculations the success rate was five out of the remaining 10 patients (50%).

The average number of IOP lowering medications prior to TSCPC was 2.6 (range 1–5). This reduced to 1.0 (range 0–3) following TSCPC at final follow-up. The number of patients on oral carbonic anhydrase inhibitors

reduced from 2 to 1. The change in the number of medications before and after treatment was assessed with a paired, *t*-test. There was a significant reduction in the number of medications pre- and post-laser treatment ($P = 0.001$). This was also confirmed with the Wilcoxon test ($P = 0.002$). The mean reduction was 1.6 (95% CI 0.8–2.3).

At the time of TSCPC, all 18 eyes had visual capability. Pre-laser visual acuity ranged from 6/24 to perception of light, with the majority (13 eyes) having visual acuities of counting fingers (CF) or worse. At final review 10 eyes had lost vision to some extent (it is not possible to quantify this owing to the poor visual acuity in the majority of patients) and vision remained unchanged in eight eyes. The proportion of patients that had lost vision was significant: 60% (95% CI of 30–81%, $P = 0.000$).

There were very few operative complications detected following TSCPC. One patient developed a mild anterior scleritis that resolved well with anti-inflammatory treatment. Another patient developed transient conjunctival burns at the site of laser application, which resolved 3 weeks post-TSCPC. There were no cases of sympathetic ophthalmia.

Discussion

The complications associated with the use of silicone oil are well recognised. The principle anterior segment complications include cataract formation, band keratopathy and glaucoma. However, it remains the favoured method of tamponade in patients with PVR and as the primary treatment in patients with giant retinal tears.^{4,5} The reported incidence of glaucoma in patients with intravitreal silicone oil is variable. Barr *et al*³

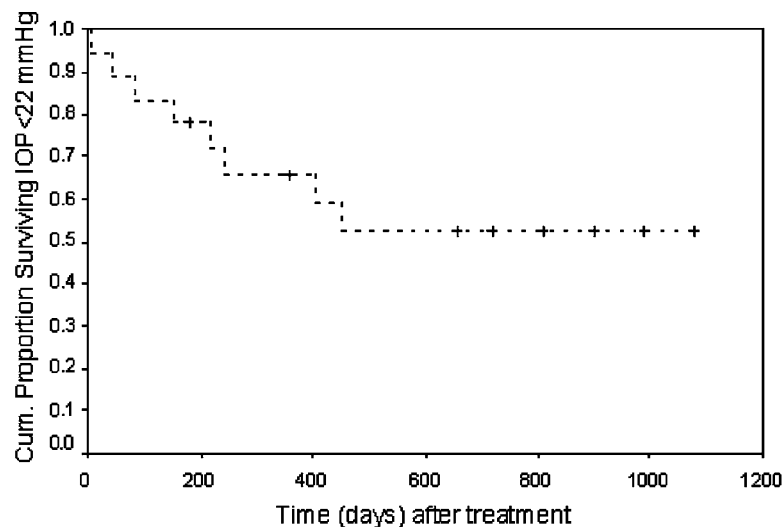


Figure 1 Kaplan-Meier plot of IOP survival. Event IOP <22 mmHg.

reported an incidence of 6% in the Silicone Study.³ Nguyen *et al*⁶ reported a higher incidence of 48%.⁵

The glaucoma associated with intravitreal silicone oil presents a difficult management problem. The mechanism of IOP elevation is not clear. Elevated IOP has been described in eyes without any evidence of anterior chamber oil and normal IOP has been reported in eyes with visible oil droplets in the anterior chamber.^{7,8} Ocular comorbidity has been proposed as an important aetiological factor in inducing an IOP rise. Inflammation, phacolysis, steroid response, pupillary block and rubeosis iridis were among such mechanisms proposed by De Corral *et al*.⁹

Removal of silicone oil is at present the primary surgical method of reducing IOP when medical treatment no longer affords control.³ Reports of successful medical control of IOP rises after silicone oil removal alone vary from three out of five patients (60%) by Casswell and Gregor⁵ and eight out of 14 patients (57%) by Nguyen *et al*.⁶ However, removal of silicone oil is not a viable option in many patients with PVR and Casswell and Gregor^{6,10} report retinal re-detachment as the most common major complication following silicone oil removal.

Other surgical options deployed include the use of Molteno implants. Nguyen *et al*.⁶ reported success rates of 60% (three out of five eyes) for Molteno implant surgery in eyes retaining silicone oil.⁵ However technical difficulties arising from extensive conjunctival scarring from multiple previous operations has limited drainage surgery from being used widely. Trans-scleral neodymium: YAG cyclophotocoagulation and cyclocryotherapy are the more common methods of cyclodestruction in current use, but the incidence of serious complications such as sympathetic ophthalmia, phthisis, dramatic loss in vision, persistent pain and increase in lens opacity has restricted their use to endstage glaucomatous eyes with little or no visual potential.²

TSCPC has recently been reported as a safe and effective method of controlling glaucoma that is refractory to medical treatment in eyes with reasonable visual potential.¹⁻³ However, there are few detailed published reports of the use of TSCPC in silicone oil-related glaucoma. One of the largest series reported is by Bloom *et al* who performed TSCPC in 210 eyes with various types of glaucoma uncontrolled on medical or surgical methods including previous cycloablative treatment. Their overall success rate was 69% for an IOP below 22 mmHg. Their group included 36 patients with silicone oil-induced glaucoma in whom they achieved a 51% reduction in mean pre treatment IOP. The mean final IOP was found to be lowest among the silicone oil group (17.3 mmHg). However, the duration of silicone oil

tamponade and the proportion of patients in whom oil was removed was not disclosed.

Soo Kyung Han *et al*³ reported a series of 11 patients with silicone oil-related glaucoma treated with TSCPC as the only surgical method of IOP control. They reported 100% success in IOP reductions at final follow-up (mean follow-up of 52.5 weeks, range 42–68 weeks) although their overall rate of success was reduced to 81.8% secondary to two patients having final visual acuities of NPL. The unusually high success rate in this paper may be due to several factors. Firstly their series consists of patients with a relatively short duration of oil tamponade. Only six (55%) of the patients had retained oil for over a year and three (27%) out of the 11 patients received TSCPC within 2 months of oil insertion. It is possible that the cause of the IOP rise in these three patients could be due factors that are amenable to nonsurgical management such as postoperative inflammation, and steroid response. Secondly, their series is limited in the length of follow-up and number of patients enrolled (11 patients). Finally, pre-existing ocular comorbidity, which could reduce the possibility of a successful outcome, was not a problem in their series.

Our result differs from those by Han *et al* and Bloom *et al* in that the success rate for IOP reduction was lower despite the use of higher mean laser energies and a higher re-treatment rate. Among the possible causes for this in our series could be the prevalence of ocular comorbidity and the longer duration of silicone oil tamponade in the eyes we treated. A significant number of patients had reduction in the number of glaucoma medications post-TSCPC. Patients with uncontrolled IOP after TSCPC were maintained on maximum tolerable medications. Additional medication would not have altered the final success rate. Our finding supports previous suggestions that TSCPC may be used to reduce the number of medications when they are not tolerated.^{2,9}

Reports of complications following TSCPC are low suggesting that TSCPC is a relatively safe treatment modality with low rates of hypotony. Bloom *et al* reported chronic hypotony in three of the 210 eyes treated. Of these, two had received previous cycloablative treatment. None of these patients had silicone oil-related glaucoma. Hypotony was noted to occur after repeat TSCPC. Han *et al* and Kumar *et al* had no cases of hypotony in their series. Our series reports two cases of hypotony following TSCP despite retaining intravitreal silicone oil. Interestingly, chronic hypotony has been associated with intravitreal silicone oil regardless of TSCPC. Barr *et al*. identified that the most significant risk factors for this were preoperative hypotony, large retinal breaks, and diffuse contraction of the retina anterior to the equator. It is difficult to know if hypotony in our patients resulted from TSCPC alone.

Our results seem to contradict previous reports of safety. Also of concern is that a significant proportion (56%) of our patients lost vision during the course of their follow-up. The majority of patients in our series had poor visual acuity at presentation with only five patients that could be quantified on a Snellen chart. Our series suggests that TSCPC fails to protect against visual loss in the long term.

Survival analysis demonstrated that there was a long delay before IOP was brought under control. This may have contributed to the further loss of vision despite treatment. However, the analysis also suggests that IOP can eventually be brought under control in most patients, but this may have been at the price of the production of hypotony in some of our patients. The limitations encountered in our study serves to highlight the inherent difficulties in managing silicone oil-related glaucoma.

In conclusion, our study of a cohort of patients in a tertiary referral centre fails to support the success rates reported so far. This raises some doubts of the efficacy of TSCPC in patients retaining silicone oil with intractable glaucoma. It is possible that the reason for this is the long duration of silicone oil and pre-existing ocular comorbidity in our patients. Larger studies with long-term results are required to know if IOP control is maintained with time and to determine patient characteristics that confer a higher risk of treatment failure. Despite its apparent limitations, the relative ease of use and general availability still makes TSCPC a worthwhile therapeutic consideration in the management of silicone oil-related glaucoma.

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