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Is transscleral cyclophotocoagulation with diode laser (TSCPC) still a valid option for refractory glaucoma? A real-world single-centre Italian experience

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Abstract

Background: To describe our experience with TSCPC with diode laser for refractory glaucoma in a single centre in southern Italy.

Methods: This retrospective descriptive study included 134 eyes with refractory glaucoma. Patients underwent TSCPC using a Cyclo-G6 laser method with a G-probe delivery system. Intraocular Pressure (IOP) and the number of Antiglaucoma Medications (AGM) were recorded at baseline and at 1-, 7-, 30-, 60-, 90- and 180-days post-treatment. TSCPC success rate was defined as an IOP between 5 and 21 mmHg or 30% reduction from baseline at the last visit (180 days) [26,27]. Statistical analysis was performed using Graph Pad Prism.

Results: IOP decrease of 30% or more from baseline was achieved in 77.6% of eyes at day 1, 100% at 90 days and 85% at 180 days. A reduction in AGM was recorded for 85% of patients. No statistical difference in IOP reduction and number of AGM was found between female and male population at 180 days. No severe complications were reported, and minor complications occurred in 4/134 treated eyes (3%).

Conclusions: In our experience TSCPC lead to an lowering of IOP in selected cases and it is still a valid option in the treatment of refractory glaucoma.

Keywords: TSCPC; Refractory glaucoma; IOP; G-probe.

Abbreviations: AGM: Anti-Glaucoma Medications; IOP: Intraocular Pressure; MPTSCPC: Micro Pulse Trans Scleral Cyclo Photo Coagulation; TSCPC: Transscleral Diode Laser Cyclophotocoagulation.

Introduction

Glaucoma is a leading cause of blindness worldwide. It includes a heterogeneous group of diseases characterized by cupping of the optic nerve head and visual-field damage. It is an optic neuropathy resulting in a progressive, irreversible loss of vision [1,2].

Elevated Intraocular Pressure (IOP) is the cardinal risk factor for this disease, and it can result either from excessive production or inadequate outflow of aqueous humour caused by an obstruction [3]. For this reason, the standard treatment strategy against glaucoma aims at reducing IOP using medications and different surgical approaches ranging from incisional to laser surgery [4].

Glaucoma progression rate usually slows down if intraocular pressure is lowered by 30–50% from baseline [1]. Refractory glaucoma is defined as an uncontrolled IOP with evidence of optic nerve and/or visual field deterioration despite maximally tolerated topical and/or systemic anti-glaucoma medications, failed surgical treatment or a combination of surgery and drugs, or a high risk of failure of trabeculectomy [5].

Traditional Transscleral Cyclophotocoagulation (TSCPC) is a laser surgery procedure whose goal is to cause controlled dam-

age to the ciliary body, the site of aqueous humour production, employing a diode laser emitting light with a near-infrared wavelength of 810 nm [6,7]. Laser light absorption by the melanin contained in the ciliary body induces the coagulation of both the pigmented and non-pigmented epithelium, which, in turn, leads to a reduction in IOP due to a decrease in aqueous humour secretion [8,9]. Limitation in TSCPC use is due to post-treatment complications that range from mild to severe. TSCPC is often considered as the last resort for the treatment of refractory glaucoma under specific conditions, such as poor visual potential or cases in which 3 patients are not good candidates for incisional surgery [6,10]. The most common complications following treatment include pain, uveitis, inflammation, eyelid swelling, hyphema, cystoid macular edema, conjunctival scarring and hypotony [11-14]. The most severe complications include phthisis bulbi, sympathetic ophthalmia, hypotony, scleral burn, scleritis, malignant glaucoma and perforation [11-14].

The purpose of this study was to retrospectively evaluate the efficacy and safety of the traditional procedure of TSCPC in patients with different types of refractory glaucoma.

Methods

Study design

Medical records of all patients with refractory glaucoma who underwent TSCPC procedure between September 2012 and March 2016 at the Ospedali Riuniti "Villa Sofia-Cervello" (Palermo, Italy), were retrospectively reviewed. The study followed the tenets of the Helsinki Declaration for research ethics.

Patients included in the study had different types of refractory glaucoma (chronic open-angle glaucoma, secondary glaucoma following vitreoretinal surgery, pigmentary glaucoma, neovascular glaucoma) defined as an IOP greater than 21 mmHg on maximal tolerated medical therapy with or without prior glaucoma surgical procedures.

Age, gender, laterality, previous surgeries/lasers, preoperative and postoperative IOP, and the number of Anti-Glaucoma Medications (AGM) were collected for each patient.

Laser intervention

Patients underwent TSCPC using the Cyclo G6 laser system (IRIDEX IQ810 Laser Systems, CA) with the G-probe delivery system, according to the manufacturer's indications. Briefly, the Gprobe footplate was aligned between the anterior border, and the middle of the limbus and 21 laser 4 applications were scattered around the 270° of the limbus (3 quadrants, 6 or 7 applications per quadrant). The superior temporal quadrant was avoided in case of future rescue filtering surgery. The laser was set at 1250 mW for 4000 ms for dark brown iris and 1500 Mw for 3500 ms for non dark brown iris, as the manufacturer suggested. Subsequent laser applications were spaced one half the width of the G-Probe footplate apart by aligning one side of the probe over the indented centre of the adjacent application. Concluding 270° treatment we Repeated laser application, if necessary, starting 45° from the first quadrant and covered half of the untreated quadrant, plus two and a half quadrants from the earlier treatment. All procedures were performed in monitored anesthesia care with retrobulbar 2% mepivacaine and adrenaline.

Patients were examined at 1, 7, 30, 60, 90 and 180 days after treatment for IOP and number of glaucoma medications were recorded. Postoperative complications were documented as well.

Outcomes

TSCPC treatment success was defined as an IOP between 5 and 21 mmHg or 30% reduction from baseline at the last visit (180 days), with no additional glaucoma medication and no other signs of glaucoma progression [26,27]. Failure was defined as an inability to meet the criteria for success or if a severe complication occurred.

Statistical analysis

Preoperative baseline IOP values were compared to IOP postoperative values at day 1, 7, 30, 60, 90 and 180. Quantitative data were expressed as mean ± Standard Deviation (SD). Statistical analysis of the difference in IOP and AGM at baseline and at post-surgery endpoints was carried out using a Student t-test in which a P value of <0.05 was considered statistically significant. All statistical analyses were performed using Graph Pad Prism 8.0.1 (La Jolla, CA).

Results

A total of 134 eyes (134 patients) were treated with TSCPC for refractory glaucoma and completed follow-up examinations at day 1, 7, 30, 60, 90 and 180 after treatment. Preoperative characteristics of all patients are shown in Table 1. The mean IOP at baseline was 38.87 ± 6.93 mmHg. None of the patients showed an IOP lower than 27 mmHg.

Table 1: Preoperative data of patients.

	Cases (N = 134
Age in years, mean ± SD	67 ± 17
Males : Females	78 (58,20%) : 56 (41.79%)
IOP* in mmHg, mean ± SD (range)	38.87 ± 6.93 (27-60)
Number of AGM‡, mean ± SD	4.57 ± 0.75
*IOP = Intraocular pressure ‡AGM = Anti-glaucoma medications	

All treated eyes had a decrease in IOP at 90 days after treatment, and 132 eyes (98.5%) maintained the decrease at 180 days. The mean values of IOP at the last two follow-up examinations (90 days and 180 days) and their percentage of decrease are shown in Table 2.

Table 2: Mean values of the Intraocular Pressure (IOP) at the last two follow-up examinations and their percentage of decrease after treatment, compared to the baseline.

	90 DAYS AFTER TREATMENT	180 DAYS AFTER TREATMENT
IOP after treatment, mmHg, mean ± SD (range	14.99 ± 3.88 (9-29)	16.78 ± 8.25 (10-45)
Decrease in IOP, % (P value)	61.4% (P<0,0001)	56.8% (P<0,0001)

The trend of IOP at baseline and at different follow-ups is shown in Figure 1. In particular, at 90 days after treatment, IOP decreased to 14.99 ± 3.88 mmHg (means ± SD) (range, 9-29), which means a 61.4% drop compared to baseline (P<0.0001). In the period between 90 and 180 days, the IOP slightly increased achieving a mean value of 16.78 ± 8.25 mmHg (mean ± SD) (range, 10-45) with a decrease of 56.8% compared to baseline (P<0.0001). The increase in mean IOP value that occurred from 90 days to 180 days was statistically significant (+11.9%, P= 0.0238).

Considering a IOP below 21 mmHg as measure of treatment success: 44 eyes (32.8%) achieved the target at 1 day, 84 (62.6%) at 7 days, 90 (67.1%) at 30 days, 98 (73.1%) at 60 days, 108 (80.59%) at 90 days and 111 (82.83%) at 180 days after treatment, showing a constant increasing trend (Table 3). Considering a post-treatment IOP decrease of 30% or more, 94 eyes (70.1%) achieved the target at day 1 after treatment, 117 (87.3%) at 7 days and 132 (98.5%) at 30 days after treatment., at 90 and 180 days 132 eyes (98.5%) and 113 eyes (84.3%) achieved the goal, respectively (Table 3).

Table 3: All the success rates at all follow-up After Treatment (AT).

MEASURES OF SUCCESS	1 DAY A.T.	7 DAYS A.T.	30 DAYS A.T.	60 DAYS A.T.	90 DAYS A.T.	180 DAYS A.T.
Eyes with IOP decrease N (%)	131 (97.7%)	134 (100%)	134 (100%)	134 (100%)	134 (100%)	132 (98.5%)
Eyes with a decrease in IOP > 30% N (%)	94 (70.1%)	117 (87.3%)	132 (98.5%)	129 (96.2%)	132 (98.5%)	113 (84.3%)
Eyes with an IOP < 21 mmHg N (%)	44 (32.8%)	84 (62.6%)	90 (67.1%)	98 (73.1%)	108 (80.59%)	111 (82.83%)

Comparing the results obtained in the male population with those observed in females, no statistically significant difference was found in terms of IOP reduction at 90 days (P= 0.2253), at 180 days (P= 0.8855) and in the number of anti-glaucoma medications at 180 days (P=0.7499). Regarding AMG, the average number of medications prescribed prior to the TSCPC treatment was 4.57 ± 0.75 (means ± SD) (range, 3-6) and it significantly decreased to 2.25 ± 1.60 (means ± SD) (range, 0-6) at 180 days after treatment, with a drop of 50.8% from baseline (P<0.0001).

Overall, 114/134 patients (85%) showed a reduction in the number of anti-glaucoma medications prescribed. In 30/134 patients (22%), the number of anti-glaucoma medications prescribed dropped to zero at 180 days.

Concerning the number of TSCPC surgery treatments, 36/134 eyes (26.8%) were re-treated, i.e. the ones that 60 days after treatment had an IOP greater than 21 mmHg. Thirty-five of those eyes had two treatments, and one eye had four treatments. When comparing the group of eyes that receive one treatment with the one that received two treatments, no significant differences were found in terms of pre-treatment IOP values (P=0.8282), IOP values at 90 days (P=0.8975), IOP values at 180 days (P=0.4818) and number of AGM at 180 days after treatment (P=0.5953). At 180 days, a reduction in IOP of 20% or more was reached in 84/97 eyes (87%) of the group with one treatment and in 28/35 eyes (80%) of the group treated twice.

Complications

Despite the relatively short follow up, no severe postoperative complications were documented (i.e. hypotony, phthisis bulbi or sympathetic ophthalmia). Minor complications were recorded for 4/134 treated eyes (2.98%). In particular, two patients experienced pupil distortion, probably due to incorrect probe positioning, and the other two eyes showed a cystoid macular oedema.

Discussion

This retrospective descriptive study evaluated the efficacy of TSCPC treatment in terms of adequate IOP control and its safety.

As evidenced by the data showed in Table 3, the efficacy of TSCPC was detectable immediately after the treatment: indeed, IOP decreases significantly already on day 1. This rapidity in reducing IOP could be considered as the real advantage of TSCPC. The decrease was maintained at all subsequent visits, and at 90 days, 98.5% of treated eyes achieved the success parameter indicated as a 30% reduction of IOP from baseline. The success rates at the last visit were also satisfactory: 84.3% and 82.83% of treated eyes achieved 30% IOP reduction from baseline and an IOP below 21 mmHg, respectively.

The IOP trend recorded at the follow-up visits was comparable to those described by other authors both with the use of TSCPC and the new Micro Pulse Trans Scleral Cyclo Photo Coagulation (MPTSCPC) [15-18], but IOP fluctuations in our sample are less marked especially for the middle follow-up stages [16,18].

We registered a significant IOP decrease from day 1 to day 7 (P<0,0001) and from day 7 to day 30 (P=0.0108). In the period between 30 and 60 days after treatment, we detected a plateau (P=0.1463) followed by a second drop in IOP occurred between 60 and 90 days (P=0.0003). At the last visit, at 180 days, we recorded an increase in IOP compared to 90-day one (P= 0.0238). Still, more than 80% of eyes achieved the success rate of IOP reduction.

The IOP values, monitored at follow-ups, showed a regular trend towards a significant decrease, with only a mild increase at the end of the follow-up period, which, however, did not compromise the success of the treatment. The results observed at the last visit exceeded our expectations, as the IOP mean value decreased by 56.8% from baseline, i.e. almost two times the expected decrease of 30%; moreover, the mean IOP value was 16.78 mmHg, clearly below the measure of success of 21 mmHg.

In our study, TSCPC also proved to be successful in reducing the number anti-glaucoma medications prescribed after treatment. We observed a decrease in AMG in 85% of patients, This is a new generation technique for the performance of transscleral Cyclophotocoagulation (CPC), previously used for retinal laser surgery [20,21]. MPTSCPC action bases on the use of a micropulse diode laser emitting short and repetitive laser light pulses separated by rest periods and on a contact probe for the trans-pars plana treatment [22,23].

In this study, we recognize several limitations: Its retrospective descriptive nature, the short follow up.

Conclusions

Our study adds a piece in favour of the use of TSCPC in refractory glaucoma patients, where this treatment could still be considered successful and well-tolerated.

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