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Research Article

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Use of Transscleral Laser in the Management of Glaucoma – Ophthalmology

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Abstract
Glaucoma is a pathology classed in the neuropathologies presented to the optic degree, of a chronic nature that structurally damages the connective tissue of the optic nerve head, in the presence of decreased neural tissue, where a progressive loss of nerve fibers is generated. The retina, excavation of the same and pallor of the pupil and consequently the beginning of usable deterioration, affecting the visual field, associated in most cases with alterations in intraocular pressure related to the development, progression and severity of the same. The drainage mechanism of the eye is located in the anterior part of the chamber angle, which in classic conditions is delegated from drainage of 83% to 93% through the different channels such as Schlemn's canal, the trabecular meshwork, the intrascleral canals, and both episcleral and conjunctival veins, in addition there are secondary drainage pathways which are a mechanism named uveoscleral drainage system which are delegated to drain the rest of the humor. Cyclophotocoagulation is an appropriate treatment option for the treatment of painful and refractory absolute glaucoma, since it preserves the ocular anatomy, relieves symptoms and reports improvements in intraocular pressure and the symptoms presented in these patients in post-intervention monitoring.

Keywords: Angle closure, Cyclophotocoagulation, Glaucoma, Glaucoma laser treatment, Neovascular glaucoma

Introduction
Glaucoma is a disease classified in the neuropathologies presented at the optic level, of a chronic nature that structurally affects the connective tissue of the optic nerve head, in the presence of decreased neural tissue, where there is a progressive loss of retinal nerve fibers , excavation of the same and pallor of the pupil and consequently the beginning of functional deterioration, affecting the visual field, associated in most cases with alterations in intraocular pressure related to the development, progression and severity of the same, the mechanism of The drainage of the eye is located in the anterior part of the chamber angle, which under normal conditions is responsible for the drainage of 83% to 93% through the different channels such as Schlemn's canal, the trabecular meshwork, the intrascleral canals, and both episcleral and conjunctival veins, there are also secondary drainage routes which are a mechanism called We have a uveoscleral drainage system which is responsible for draining the rest of the aqueous humor, that is, 5%-15% of the aqueous humor that is formed and its exit occurs through the anterior face of the ciliary body, the ciliary musculature until it reaches the suprachoroidal area and finally leaves the eye through

the scleral canals. When this aqueous humor drainage system is affected, there is an increase in the pressure of the anterior chamber of the eye, which is also reproduced in the posterior chamber. (Vitreous humour), causing alterations at the level of the arterial irrigation of the optic papilla leading to a gradual degeneration of the optic nerve that can lead to progressive blindness [1].

This disease can be classified according to the opening of the chamber angle, the angle is located at the junction of the cornea, iris and sclera, and extends 360 degrees around the periphery of the iris. The special channels located in the corners of the chamber angle allow the return of aqueous humor to the blood circulation of the eye, manifesting as primary open-angle glaucoma or it can present as a secondary pathology due to increased resistance to the outflow of aqueous humor at the level of the eye of the trabecular meshwork or also due to increased episcleral venous pressure [2]. Angle-closure glaucoma can be caused by elevated intraocular pressure due to angle closure or the presence of anterior peripheral adhesions [1,2]. Angle-closure glaucoma can also be secondary to a variety of mechanisms that cause the iris to move back and forth or cause anterior traction on the iris, thereby interrupting aqueous outflow through the trabecular meshwork, depending on the world health organization and these in turn present some variants such as secondary glaucoma given by diseases such as diabetes, medications such as corticosteroids, eye injuries and the presence of uveitis, other types are also recorded such as congenital glaucoma given in babies when there are an incorrect development in the ocular drainage channels during the perinatal period and normal tension glaucoma, which is a type of glaucoma in which the optic nerve suffers damage regardless of whether the intraocular pressure is normal (below 21 mmHg) or low. Which makes it an infrequent presentation, this disease is cataloged according to the world health organization as the second cause worldwide. Worldwide cause of irreversible blindness [1,2,3].

Among the different types or forms of presentation of glaucoma, neovascular glaucoma is the most frequent, this is a frequent form in diabetic patients and is produced by the formation of fibrovascular membranes at the level of the chamber angle as a consequence of the stimulation of the angiogenesis due to diseases that cause ocular ischemia. Patients with proliferative diabetic retinopathy can have a disease that is difficult for ophthalmologists to treat, due to its various complications and the alterations presented at the ocular level [2,3].

It is statistically established that about 50% of patients do not know that they have glaucoma, since in most cases it does not present obvious symptoms, which makes it go unnoticed by the patient until the disease is advanced and the damage caused are truly important, thus affecting the quality of life of the patient, the manifestations produced by this disease are intense headache, eye pain, nausea, vomiting, blurred vision, halos around lights, redness, blind spots and irregular peripheral vision It mainly affects the age group between 50 and 80 years of age [3].

The treatment of this pathology is based on regulating intraocular pressure using thermal therapies such as cyclocryotherapy or minimally invasive surgical alternatives such as non-perforating deep sclerotomy, trabeculectomy or drainage implants, accompanied by the use of drugs such as ocular hypotensives, cycloplegic mydriatics, anti-inflammatories, among others, however some patients do not respond adequately to these conventional alternatives due to the severity and progression of the disease, putting their vision at risk and causing intense pain, turning into refractory glaucoma and being unsuitable for conventional alternatives, it is because this that in most of these patients cyclodestructive procedures are used where we find the use of transscleral laser for the management of glaucoma, this alternative known as transscleral cyclophotocoagulation by means of laser, has gained greater recognition compared to alternatives surgical procedures mentioned above and in the last two decades this technique has been introduced in a stronger way in the treatment of refractory glaucoma, painful glaucoma and neovascular glaucoma, it has also been shown that it is a useful alternative in the management of glaucoma secondary to rhegmatogenous retinal detachment treated with intraocular silicone, significantly improving intraocular blood pressure figures [4,5].

Transscleral cyclophotocoagulation is an extraocular procedure in which a laser probe is placed outside the sclera to destroy the ciliary body and epithelial cells. Several studies have compared the effectiveness of this technique with respect to others such as cyclocryotherapy, however, this practice has shown efficacy and improvement in the patient's conditions and quality of life, this technique consists of the use of an Nd:YAG laser, argon or diode laser thus reducing the production of aqueous humor through photocoagulation of the ciliary tissue, this procedure is performed under local anesthesia and can be examined transsclerally (used more frequently) or endoscopically. Some patients require more than one cycle of treatment to obtain the expected results, however, the procedure is very effective and relatively low risk. The use of this practice was initially limited to end-stage refractory glaucoma, but it is currently applied to eyes with preserved visual acuity where other therapies have failed, such as those already mentioned [5,6].

The loss of visual acuity is reported as the main complication in this group of cyclodestructive therapies, however, the use of this alternative reports that the postoperative intraocular pressure values in reference to the preoperative ones showed favorable results, evidencing a reduction in intraocular pressure of up to 30% which improves by 60% to 90% in a period of approximately 10 to 30 months after the intervention. This laser treatment alternative is indicated mainly for pain relief, it is considered useful in patients with glaucoma that do not resolve with conventional medical therapy and it has been shown that the reduction in pain intensity after cyclophotocoagulation allows us to affirm that it is an effective method for relieving this type of glaucoma, since it reduces intraocular pressure and relieves pain and neovascular regression in patients with neovascular glaucoma and does not produce variations in visual acuity [4,6]. Cyclophotocoagulation is an appropriate treatment option for the treatment of painful and refractory absolute glaucoma, since it preserves the ocular anatomy, relieves symptoms and reports improvements in intraocular pressure and the symptoms presented in these patients in post-intervention monitoring. This is why the use of this alternative is recommended for the treatment of glaucoma that does not respond to conventional alternatives (pharmacological and surgical), significantly improving the patient's quality of life [6,7].

Methodology

To carry out this article, a bibliographic search was carried out in various databases such as Elsevier, Scielo, Medline, pubmed, ScienceDirect and Ovid, thus selecting original articles, case reports and bibliographic reviews from 2024 to 2022, in Spanish and English. Using MeSH terms: glaucoma, glaucoma laser treatment, closed angle, neovascular glaucoma, cyclophotocoagulation and the Boolean operators and and or. Thus including all the documents that will deal with transscleral laser treatment for glaucoma management, the data found were between 12-25 records, thus using 14 articles for the preparation of this document.

Results

In a study conducted in the United States, they retrospectively reviewed the cases of transscleral diode cyclophotocoagulation (TSPCC) during a period of 15 years in which they compared the demographics of the patients, evaluated the configuration of the diode laser more specifically the slow coagulation versus the standard "pop" titration setting, and other characteristics such as pain, clinical outcomes given in terms of vision, intraocular pressure (IOP), need for additional laser treatments, and medications the patient have used for glaucoma or if you have undergone other surgeries associated with the treatment of this condition after treatment with cyclophotocoagulation (CPC). The study results were based on a total of 78 eyes with glaucoma who underwent TSCPC at Bascom Palmer Eye Institute (BPEI) between July 1, 1995 and June 30, 2015 who met the criteria established in their study, of these 52 patients underwent slow coagulation CSPCW and these were compared with 26 eyes that underwent standard "pop titration" CSPCW.

This study showed a statistically significant increase in LogMAR VA between the initial and final view comparison of 0.21 (0.51) LogMAR units (p = 0.001) in both groups combined. This increase was significant in both the slow coagulation group [0.18 (0.47), p = 0.032] and the standard pop group [0.32 (0.56), p = 0.015]. The final LogMAR VA was similar between the two groups (p = 0.592). A statistically significant decrease in IOP was found between the initial and final visits of 17.77 (13.63) mm Hg (p<0.001) for both groups. In addition to this, the only significant difference detected between the groups of patients was the incidence of complications. The slow coagulation group was found to have fewer eyes that experienced one or more complications (48.1% vs. 73.1%, p = 0.036). However, the need for additional procedures, visual acuity (VA) reduction (≥ 0.2 LogMAR change), vision loss (VA with hand movement (HM) vision, or (to LP or PNL) and IOP results were similar between the two groups of patients.

Forty-two percent of patients in the slow coagulation group and 35% in the standard therapy group did not experience a significant decrease in visual acuity during follow-up. Regarding intraocular pressure (IOP), it remained below or equal to 21 mmHg during the follow-up period in 46% of the patients with slow coagulation and in 44% of the standard group (p = 0.870).

A cumulative proportion was performed on patients in need of additional treatment, either visual acuity reduction (≥ 0.2 LogMAR change), or vision loss (VA of LP or NLP) and data from certain IOP ranges. They were analyzed with the Kaplan-Meier survival analysis (Table 1) [8].

Table 1: Outcome variables in the slow and standard coagulation groups

		TSCPC Method				
Variable		**Slow clotting (n = 52)**	**Standard pop (n-26)**	**Value p**		
Event Comparisons						
Patient Needs Second TSCPC	No	38 (73,1%)	20 (76,9%)	0.714		a
	Yes	14 (26,9%)	6 (23,1%)			
Patient Required Second TSCPC or other treatment	No	37 (71,2%)	20 (76,9%)	0.588		a
	Yes	15 (28,8%)	6 (23,1%)			
The patient required a greater number of medications	No	40 (76,9%)	20 (76,9%)	1,000		a
	Yes	12 (23,1%)	6 (23,1%)			
The patient had one or more complications.	No	27 (51,9%)	7 (26,9%)	0.036	*	a
	Yes	25 (48,1%)	19 (73,1%)			
VA loss experienced by the patient (VA de LP o NLP) f	NO	27 (71,1%)	13 (65,0%)	0.636		a
	Yes	11 (28,9%)	7 (35,0%)			
The patient experienced reduced VA (change => 0,2 LogMAR) f	NO	16 (42,1%)	7 (35,0%)	0.599		a
	Yes	22 (57,9%)	13 (65,0%)			
The patient experienced an IOP below 15 mmHg	NO	22 (44,0%)	8 (32,0%)	0.317		a
	Yes	28 (56,0%)	17 (68,0%)			
The patient experienced an IOP greater than 15 mmHg	NO	12 (24,0%)	4 (16,0%)	0.425		a
	Yes	38 (76,0%)	21 (84,0%)			

The patient experienced an IOP greater than 20 mmHg	NO	23 (46,0%)	11 (44,0%)	0.870		a
	Yes	27 (54,0%)	14 (56,0%)			
Quantity Comparisons						
Number of complications	Half (DE)	0,62 (0,75)	1,46 (1,24)	0.002	* *	C
	median	0	1			
Number of drugs increased	Halsf (DE)	0,42 (0,94)	0,42 (0,95)	0.989		C
	Median	0	0			
Maximum number of drugs	Half (DE)	4.04 (1.14)	4,04 (1,34)	0.771		C
	Median	4	4			
Months of Follow-up	Half (DE)	16,36 (20,1)	24,68 (28,58)	0.124		C
	Median	11	16			
Time-to-event comparisons						
Survival time to second TSCPC (months)	Half (SE)	44,4 (4,8)	49.6 (7)	0.642		D
	median (SE)	62,1 (32,7)	mi			
Survival time to second TSCPC or other treatment (months)	Half (SE)	42,7 (4,9)	49.6 (7)	0.504		D
	median (SE)	62,1 (32,8)	mi			
Survival time (months) until VA loss f	Half (SE)	39.9 (8)	42,7 (7,2)	0.466		D
	median (SE)	24,1 (1,3)	43,9 (7,3)			
Survival time (months) to VA reduction f	Half (SE)	23 (5.2)	23 (6,8)	0.998		D
		Method TSCPC				
Variable		slow clotting (n = 52)	Standard pop (n-26)	valor p		
	median (SE)	12,6 (4,9)	4,9 (7,4)			
Survival time (months) at IOP above 15 mmHg	Half (SE)	7.9 (1.4)	5.4 (1.8)	0.290		D
	median (SE)	2,8 (0,8)	1,6 (0,2)			
Survival time (months) at IOP above 21 mmHg	Half (SE)	28,5 (4,7)	30,3 (6,9)	0.926		D
	median (SE)	7.8 (3.6)	6,5 (2,6)			
Results of visual acuity and Intraocular pressure						
VA finals	Half (DE)	2,05 (0,81)	1,90 (0,94)	0.592		h
VA increase from baseline	Half (DE)	0,18 (0,47)	0,32 (0,56)			I
Final IOP (mmHg)	Half (DE)	18,84 (9,46)	18.95 (12.10)	0.969		h
IOP Decline from Baseline (mmHg)	Half (DE)	17.19 (13.31)	18,86 (14,47)			I
* * * value p <= 0.001, * * value p <= 0.01, * value p <= 0.05						
a - chi square test; c - Mann-Whitney test; d - Kaplan-Meier log-rank test survival analysis; e - it was not possible to estimate the median; f - includes only cases with initial VA better than LP; g - any time after the initial surgical date; h - paired t-test; i - final VA and IOP of each group was compared to baseline values with paired t-tests, TX = treatment.						

Retrieved from: In partnership with the transscleral diode laser cyclophotocoagulation a comparison of slow coagulation and standard coagulation techniques. Ophthalmol Glaucoma 2018; 1(2):115-22.

At the Quilmes Petroleum Center, a high complexity center located in the province of Buenos Aires (Argentina), they conducted a retrospective cohort study in 143 eyes of patients with various subtypes of glaucoma between October 2016 and December 2018. These patients were grouped together. For the analysis with some characteristics which were, glaucoma subtype, preoperative demographics, medical history with emphasis on previous surgical procedures and postoperative results. Thus, a collection of data was based on intra- and postoperative complications, intraocular pressure, visual acuity, the need for micropulse retreatment, incisional glaucoma surgery, and the need for an increase in the dose/amount of medication.

The study included 143 eyes of 110 patients treated according to the study procedure (transscleral diode laser). Of these, 78 patients had an intervention in one eye. Overall, 82.5% of the eyes had a history of glaucoma surgery. The mean age was 70 years, with an interquartile range of 51 to 77 years, and 53% of the patients were male.

The success of the study showed an achievement in 118/130 (91%) at 3 months after performing the intervention, in 109/120 (91%) at 6 months and in 77/90 (86%) at 12 months after surgery. treated. The patients who obtained an intraocular pressure (IOP) below 20 mmHg were 111 (78%) at 24 h, 104 (80%) at 3 months, 93 (77%) at 6 months and 70 (78%) at 12 months.

It was shown that the average use of medications decreased from 3 to 2 at 12 months post-surgical treatment and approximately 75% of the patients were able to refuse a medication ($p = 0.0001$) [9]. It was found that only 10 of 90 patients (11.1%) achieved a target intraocular pressure (IOP) without the use of medication. In the neovascular and non-neovascular patient groups, both had significant clinical reductions. In the nonvascular group, the difference between baseline IOP and IOP at 24 h and at 3, 6, and 12 months was significant, with $p \leq 0.0001$ in each comparison. Likewise, the comparison in the neovascular group between baseline IOP and IOP at 24 h and at 3, 6 and 12 months was significant, with pgs ≤ 0.05 in each comparison. In the different subtypes of nonvascular glaucoma, the mean IOP decreased from 23.7 to 16.4 mmHg (95% CI: 15.34-17.42) at 12 months, while in patients with neovascular glaucoma, the IOP decreased from 56.7 to 20.0 mmHg (95% CI: 13.44). –26.57).

The results of the micropulse treatment are evidenced in Table 2. Of which overall, 42 patients (29.4%) exhibited at least one treatment failure during the course of the study and 36 received another micropulse intervention. In the study, it was observed that the patients who did not reach the target pressure with the maximum treatment or presented intolerance, after 12 months of the micropulse procedure, 86% achieved success, 78% reached an IOP below 20 mmHg and the 74% were able to descend. A drug (topical or oral acetazolamide). The mean reduction after treatment of any type of glaucoma (excluding the neovascular type) was 7.3 mmHg, that is, 31% below baseline IOP. Less than a third of patients required additional treatment due to treatment failure within 12 months of follow-up.

Retrieved from: Assessment of efficacy and safety of micropulse diode laser treatment in glaucoma: One year follow-up. Archives of the Spanish Society of Ophthalmology (English Edition), 95(7), 327–333.

In a study of 28 patients, 28 eyes were selected, of which two patients were excluded due to the use of oral analgesics in the immediate postoperative period, 11 (42.3%) were men and 15 (57.3%) women. of which 14 (53.9%) were right eyes and 12 (46.1%) left eyes. Of these, 16 patients underwent standard transscleral cyclophotocoagulation (TSCPC) treatment and 10 patients underwent slow-cooker transscleral cyclophotocoagulation (SC TSCPC) technique. Follow-up time for all was 90 days.

During treatment in patients with TSCPC, the average load used was 58 J ± 19 J, and 60 J in the TSCPC SC group. Table 3 illustrates the IOP reduction in the post-treatment follow-up periods between the two techniques used.

Table 2: Mean PIO before and during follow-up after treatment

	TSCPC (n=16)	TSCPC SC (n =10)	Valor P
Pre	49± 23 mm Hg	54± 16 mm Hg	0.27
1er PO	32± 24 mmHg	38± 22 mmHg	0.26
30 PO	38± 18 mmHg	39± 10 mmHg	0.43
PO 90	43± 10 mmHg	44± 09 mmHg	0.40
Consideration of standard transscleral cyclophotocoagulation (TSCPC), slow cooking transscleral cyclophotocoagulation technique (TSCPC SC), and postoperative day (PO).			

Retrieved from: Transscleral cyclophotocoagulation treatment for painful eye with neovascular glaucoma. Rev Bras Oftalmol. 2020; 79(1):38-41.

Discussion

Based on the results of this article, we can say that patients who underwent slow coagulation CSPC compared to those that underwent standard CSPC obtained results that included visual acuity and intraocular pressure; the results were similar in both groups of patients, as both had clinically significant decrease in IOP from baseline to final visits, post-procedure complications were also assessed in both groups where the average number of complications for patients in the slow coagulation group was lower compared to the standard TSCPC group, mainly due to a reduction in prolonged postoperative swelling in the coagulation group; other articles suggest that the efficacy, safety, and optimization of diode laser TSCPC is ongoing and not well reported, making the present results relevant to the clinician. TSCPC has traditionally been reserved as a treatment for refractory glaucoma in eyes with poor visual acuity, poor visual potential, and painful blind eyes associated with high IOP. This is mainly due to the common opinion that TSCPC has significant complications, such as prolonged inflammation, pain, and even consumption.

Serious complications associated with previous cyclodestructive procedures, and cyclocryodestruction; although recent reviews of the literature and the results of this study suggest that diode laser TSCPC is a minimally invasive intervention that offers the potential for significant IOP reduction and a favorable complication profile in the management of refractory cases of glaucoma.

Other studies carried out suggest that TSCPC is a procedure that presents variable results, and that it can be seen as a repetitive non-invasive intervention for glaucoma. Keeping in mind that variations in ciliary body anatomy and pigmentation may further influence success and may explain why response to treatment varies from individual to individual. A study conducted in Brazil and published in 2020 shows that standard TSCPC was able to reduce IOP by 34.7% on the first postoperative day and by 12.2% on the 90th day. In the group treated with TSCPC SC, the reduction on the first day was 30% and 19% at the end of 90 days, this justifies a possible recovery of the damaged ciliary body part, which can lead to an increase in the IOP.

A study conducted in the United States and published in 2019 where the records of 95 consecutive patients with various subtypes of glaucoma who underwent micropulse transscleral cyclophotocoagulation were reviewed, Patients were considered successfully treated if their intraocular pressure was reduced by at least one 20% compared to baseline, where the primary measure was postoperative intraocular pressure; and also taking into account the number of adverse events and complications that occurred with the treatment; had as results that On average, the IOP was lower than the initial measurement at all postoperative time points of said study. Mean preoperative IOP was 25.1±5.3 mmHg. The mean postoperative IOP at one week was 15.1±5.3 (p=0.002) and at 12 months it was 17.5±5.1mmHg (p=0.004). Compared to baseline, the mean IOP at 12 months was reduced by 30.3%. The mean initial number of topical medications used by patients was 3.0 ± 1.1. The number of topical medications used by patients was also reduced at each postoperative time point investigated compared to baseline. The number of medications used at postoperative week 1 was 1.2 ± 1.1 (p = 0.001) and 1.4 ± 1.0 at postoperative month 12 (p = 0.03). Treatment success with an MP-TSCPC treatment was achieved in 73 of 95 patients (76.8%), taking into account the results of this study we can say that the use of MP-TSCPC to treat glaucoma has good results in the recovery of patients as also shown in the results of this study, supporting the benefits of this treatment [10-14].

Conclusions

The reduction in IOP figures obtained coincides with other authors who state that this varies from the start of treatment to the year of follow-up, so this technique is an effective method for this purpose. Pain relief is an indication for transscleral contact cyclophotocoagulation, and it is most useful in patients with glaucoma who failed to compensate with medical treatment, had visual acuity less than 0.3, and visual field less than 5 degrees. . The reduction in pain intensity after contact transscleral cyclophotocoagulation is what allows us to affirm that it is an effective method for its relief in this type of glaucoma. Transscleral contact cyclophotocoagulation provides a reduction in intraocular pressure with relief of pain and regression of neovessels in patients with neovascular glaucoma, and there is no change in visual acuity.

Transscleral cyclophotocoagulation produces coagulative changes that destroy the pigmented and non-pigmented ciliary epithelium, and the stroma along with the capillaries in the ciliary process. These alterations decrease IOP due to decreased secretion of aqueous humor due to coagulative necrosis of the ciliary body, due to the absorption of laser energy by the ciliary epithelium; the other factor is ischemia caused by the spread of energy hitting the ciliary body, or by tissue disruption affecting nearby capillaries.

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