THE LONGTERM EFFECT OF DIODE LASER CYCLODESTRUCTION ON INTRAOCULAR PRESSURE

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SUMMARY

We retrospectively reviewed the first 24 patients (26 eyes) who underwent ab externo diode laser cyclodestruction for refractory glaucoma and who had a follow-up of at least 10 months. We compared the intraocular pressure (IOP) and the number of anti-glaucomatous medications used pre- and postoperatively. The mean follow-up period was 28 months (range 10 to 50 months). The mean IOP before and after treatment was respectively 30 ± 12 mmHg and 22 ± 12 mmHg ($p < 0.05$), a mean reduction of 29%. The average number of treatment sessions was 1.5 (range 1 to 5). An IOP ≤ 21 mmHg was obtained in 65% of the cases; an IOP ≤ 17 mmHg was achieved in 46% of the cases. The mean number of anti-glaucomatous medications used pre- and postoperatively was respectively 2.3 and 1.7 ($p < 0.05$). Only mild postoperative uveitis was observed; no eye developed phthisis bulbi.
The study suggests that diode laser cyclodestruction is a safe procedure that can reduce the IOP in the long term in patients with refractory glaucoma.

RÉSUMÉ

Une étude rétrospective a été réalisée sur les 24 premiers patients (26 yeux) traités par cyclophotocoagulations au laser diode pour un glaucome réfractaire, présentant un recul d'au moins 10 mois. Nous avons comparé la pression intra-oculaire (PIO) et le nombre de médicaments utilisés avant et après traitement. Le recul moyen était de 28 mois (min 10 et max 50 mois). La PIO moyenne était 30 ± 12 mmHg avant traitement et 22 ± 12 mmHg après traitement ($p < 0.05$), soit une réduction moyenne de 29%. Le nombre moyen de traitements effectués était de 1,5 (de 1 à 5). Une PIO ≤ 21 mmHg a été obtenue dans 65% des cas; une PIO ≤ 17 mmHg a été atteinte dans 46% des cas. Le nombre moyen de medicaments utilisés avant traitement était 2.3, et après traitement 1.7 ($p < 0.05$).
Nous n'avons observé qu'une réaction inflammatoire modérée du segment antérieur en postopératoire; aucun cas n'a développé de phtise.
Notre étude suggère que la cyclophotocoagulation au laser diode est un traitement sûr, pouvant réduire à long terme la PIO dans les glaucomes réfractaires.

KEY-WORDS

Diode laser cyclodestruction, intraocular pressure, refractory glaucoma.

MOTS-CLÉS

Cyclophotocoagulation au laser diode, pression intra-oculaire, glaucome réfractaire.

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INTRODUCTION

The concept of cycloablation has been present for several decades and it still plays an important role since it can be the treatment of last resort for patients with refractory glaucoma (1). Because of the problems associated with cyclocryodestruction such as uveitis, loss of visual acuity, pain and phthisis bulbi, diode laser cyclophotocoagulation has gained more interest (2, 9). Several studies showed that diode laser cyclodestruction can be a safe and effective procedure in the short term (2,3,6,9,12). The purpose of our study was to analyse the long-term effect of the first 26 cases of diode laser cyclodestruction performed in our department.

MATERIAL AND METHODS

We reviewed the charts of the first 38 patients who underwent ab externo diode laser photocoagulation for refractory glaucoma. Refractory glaucoma was defined as advanced glaucoma uncontrolled with the other methods of medical and surgical therapy. We only included patients with a minimum follow-up of 10 months. We divided the patients into 5 subgroups: primary open-angle glaucoma (POAG), secondary open-angle glaucoma (SOAG), neovascular glaucoma (NVG), congenital glaucoma (CG) and chronic angle-closure glaucoma (CACG).

The treatment was performed in an outpatient setting, and under local anesthesia (retrobulbar injection), except for two patients where the treatment was performed under general anesthesia. We used the semiconductor diode laser system from IRIS Medical Instruments. The laser delivery quartz fiber optic diameter was 600 micrometers. Its planar polished end protruded 0.7 mm from a hand piece (G-probe) fabricated in a shape to encourage accurate fiber optic location centered 1.2 to 1.5 mm posterior to the surgical limbus and oriented parallel to the visual axis (4, 9). The same probe was used up to 5 times. Rough calibration was performed by burning a hole through a blackened piece of sterilized paper with the settings at 1 W and 1''. The probe was then carefully cleaned before the treatment was initiated. Subsequent laser applications were spaced one half the width of the probe tip (2 mm) by aligning the lateral edge of the probe on the center of the last application (4, 9). We treated 220° of the inferior circumference of the ciliary body with 17-19 impacts of 2 seconds with gentle indentation. Applications started with a power of 1.75 W. If there was no tissue-disruption reaction (a 'pop' or 'snap' sound from within the eye) during the first 2 applications, the power was increased to 2 W. If there was a 'pop' or 'snap' during more than one subsequent laser application, the power was reduced back to 1.75 W. If a 'pop' or 'snap' sound occurred at 1.75 W during more than one laser application, we reduced the power to 1.5 W, and completed treatment at this power (4, 9).

After treatment, the patients used topical steroids 3 times a day for 3 weeks, additionally to the preexisting anti-glaucomatous medications. If the IOP reduction was sufficient, the anti-glaucomatous medications were reduced.

If the first diode treatment was not effective enough i.e. minimum 20% IOP reduction but less than the target pressure or if the IOP reduction did not last, another treatment session (up to 5) was performed at least 1 month later.

The mean of the 3 last IOP's before diode treatment was compared with the mean of the 3 last IOP's after treatment. We also noted the visual acuity and the total number of anti-glaucomatous medications before treatment and at the last follow-up visit.

Summary statistics are reported as the mean standard deviation. Paired t-test was used to calculate differences between group means.

RESULTS

The charts of 38 patients (40 eyes) were reviewed; 24 patients (26 eyes) had a minimum follow-up of 10 months and were included in our study. The patients' characteristics are summarized in table 1. The mean follow-up period was 27.8 months (range 10 to 50 months).

The mean IOP decreased from 30.2 ± 11.7 mmHg before diode cyclodestruction to 21.6 ± 11.5 mmHg after diode cyclodestruction ($p = 0.0002$). This represents a mean reduction of 29%. An IOP ≤ 21 mmHg with or without

Table 1: Patients' characteristics

Patients (n)	24
Age (range)	58 (17-89)
Sex (M/F)	15/9
Subgroups of glaucoma:	
POAG	4
SOAG	15
NG	4
CG	2
CACG	1
Follow-up (Mo.)(range)	28 (10-50)

1. POAG = primary open-angle glaucoma
2. SOAG = secondary open-angle glaucoma
3. NVG = neovascular glaucoma
4. CG = congenital glaucoma
5. CACG = chronic angle-closure glaucoma

medication was obtained in 65% of the cases and an IOP ≤ 17 mmHg in 46% of the cases. A minimum 20% IOP reduction was obtained in 62% of the eyes. Ten of the eyes (38%) were non-responders (i.e. < 20% IOP reduction); 60% of those had a pre-treatment IOP ≤ 21 mmHg. Figure 1 shows a scatter chart of the mean IOP pre- and post-treatment. Table 2 summarizes the detailed results per eye.

The mean number of diode treatments was 1.5 (range 1 to 5). In 18 eyes (69%) only one treatment was given, and 6 eyes (23%) underwent 2 diode treatments. In 1 eye 3 treatment sessions were necessary and one eye underwent 5 diode treatments. The latter eye failed to respond and eventually underwent a tube implantation to obtain an adequate IOP reduction. In this case, the fourth and fifth diode treatment were completed under general anesthesia because the third treatment was too painful under retrobulbar anesthesia.

The mean number of medications required decreased from 2.3 ± 0.9 before diode treatment to 1.7 ± 1 after treatment ($p < 0.05$).

Analysing the subgroups, we found that the pressure lowering effect of diode cyclodestruction was the highest in the group with neovascular glaucoma (NVG). In this group, we noticed a mean pressure lowering effect of 53%; the mean IOP before treatment was 40 mmHg. For the group with primary open-angle glaucoma (POAG) there was no IOP lowering effect; the mean IOP before treatment in this group was 17 mmHg. For the 3 other subgroups, the IOP lowering effect was about 24%.

Preoperative visual acuity (VA) ranged from light perception (LP) to 6/10. Thirteen eyes (50%) had preoperative vision ranging from LP to counting fingers. The other 13 eyes had preoperative vision of 1/10 or more. Postoperatively, after a mean of 28 months, 11 eyes (42%) had

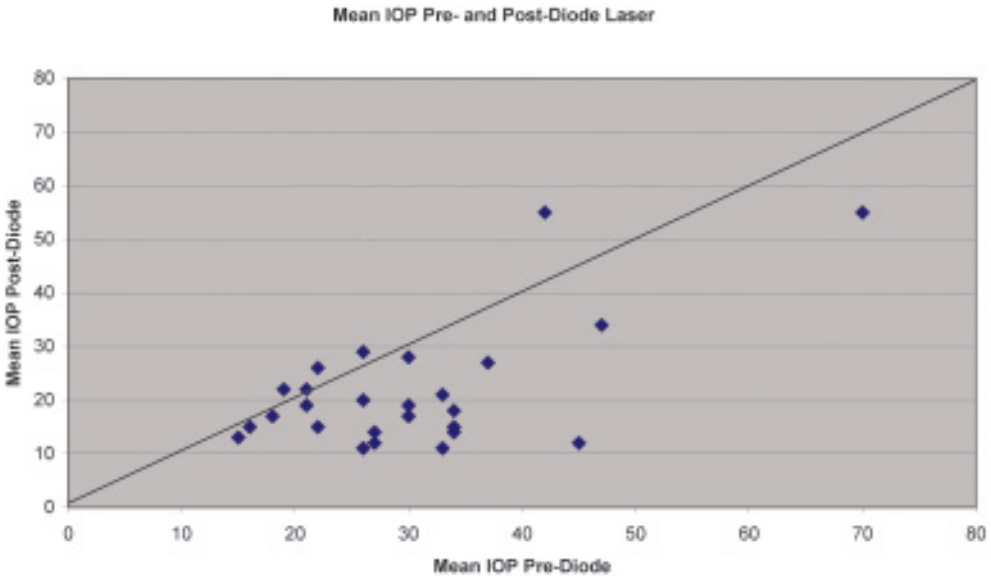

Fig 1. Mean IOP pre- and post-diode laser cyclodestruction

Table 2: Detailed listing of the results per eye

Eyes	Diagnosis	Mean IOP pre-diode (mmHg)	Mean IOP post-diode (mmHg)	Nr of medications pre-diode	Nr of medications post-diode	Follow-up time (months)	Nr of treatments
1	SOAG	34	14	3	1	50	1
2	SOAG	27	12	2	1	10	2
3	SOAG	21	19 *	2	2	20	1
4	SOAG	22	15	1	0	37	1
5	POAG	16	15 *	2	2	43	1
6	SOAG	30	28 *	1	1	38	2
7	SOAG	22	26 *	3	3	47	1
8	SOAG	30	19	1	1	32	2
9	CACG	70	55	1	1	36	1
10	SOAG	42	55 *	1	1	25	2
11	POAG	19	22 *	3	3	30	1
12	POAG	15	13 *	3	3	30	1
13	NG	47	34	2	1	33	3
14	NG	34	18	3	2	27	1
15	POAG	18	17 *	3	1	32	1
16	SOAG	27	14	1	1	37	1
17	NG	45	12	2	1	18	1
18	SOAG	26	20	3	2	18	1
19	SOAG	34	15	3	2	26	2
20	SOAG	37	27	2	1	13	1
21	CG	30	17	3	2	31	1
22	SOAG	26	29 *	2	2	18	5
23	CG	21	22 *	4	4	21	1
24	NG	33	11	2	1	22	1
25	SOAG	33	21	4	3	10	1
26	SOAG	26	11	3	3	18	2
Mean		30.19	21.58	2.3	1.73	27.77	1.46
Min		15	11	1	0	10	1
Max		70	55	4	4	50	5
SD		11.69	11.54	0.93	0.96		0.90

*: non-responders

a decreased VA, 5 eyes (19%) had an improved VA and the remaining 10 eyes (39%) retained the same VA. If we closely looked at the 13 eyes with VA ranging from 1/10 to 6/10, we found that 6 eyes (46%) had a decreased VA of 2 or more Snellen lines and 2 eyes (15%) had an improved VA of 2 or more Snellen lines. Two of the 6 eyes with a loss of ≥ 2 Snellen lines lost this acuity within one month after treatment.
In our study, we noted preoperatively the presence of 2 blind, painful eyes. One eye had pain relief after diode laser; this eye, with neovascular glaucoma, showed an IOP reduction of 73%.
Only mild postoperative uveitis was observed; no eye developed phthisis bulbi, hypotony or sympathetic ophthalmia.

DISCUSSION

This study shows that contact diode laser cyclodestruction can induce a substantial IOP reduction in the long-term in eyes that have exhausted all other treatment modalities.
The IOP lowering effect of cyclodiode was the highest in patients with neovascular glaucoma. Walland (14) reported that, particularly in the neovascular glaucoma group, the IOP lowering effect of cyclodiode was variable. Linsen

et al. (9) and Detry-Morel et al. (3) found that failures were more frequent in eyes with neovascular glaucoma, although the latter studies had a shorter follow-up (less than 5 months). We are aware that, due to the low number of patients in each of our subgroups, it is impossible to draw conclusions about the pressure lowering effect of cyclodiode in subtypes of glaucoma.

Our study also illustrates that diode laser cyclodestruction reduces the number of medications required for appropriate IOP control. This was in accordance with Bloom et al. (2), Detry-Morel et al. (3), Linsen et al. (9), Spencer et al. (11) and Threlkeld et al. (12). By reducing the number of medications used, diode laser cyclodestruction might also diminish the overall cost of glaucoma treatment (2). Conversely, Kirwan et al. (7) noticed that diodecyclodestruction did not decrease the number of medications used; however this was a study of pediatric patients with uncontrolled glaucoma.

Our retreatment rate of 31% was comparable with Gupta et al. (5) who had a retreatment rate of 42%, with Spencer et al. (11) who retreated 45% of the eyes, and with Detry-Morel et al. (3) who had 21% retreatments. Our non-responder rate was 38%. If we consider all 40 eyes (with a follow-up from 3 to 50 months), we had a non-responder rate of 50%. Since 60% of the non-responders had a pre-operative IOP $\leqslant$ 21 mmHg, it seems that diode laser cyclodestruction is less effective in reducing the IOP in patients with pressures below 21 mmHg. Another reason for failure might be that the corpus ciliare was not perfectly targeted. Exact preoperative localization of the corpus ciliare with transillumination may allow better targeted destruction (1).

This study demonstrates that it is a reasonably safe and well-tolerated procedure. Cyclodiode has been compared with YAG laser cycloablation in the adult population (7, 15). Both modalities offer similar treatment effects, but YAG laser treatment may have a higher rate of significant adverse effects, including sympathetic ophthalmia (7, 8, 13). This may be because the rate of delivery of each energy pulse is much higher with the YAG laser. One potential disadvantage of using the contact diode laser for cycloablative procedures is that there may be a higher re-treatment rate compared with YAG laser cycloablation, at least in adults (7, 10).
Loss of visual acuity still remains an important concern. In our analysis, 42% of eyes had a decreased VA. Threlkeld et al. (12) mentioned 38% deterioration in VA and Walland (14) 41%. Of eyes with a VA 1/10 or better pre-treatment, 46% have lost 2 or more Snellen lines; this was comparable with Spencer et al. (11), who noted that 32% of the eyes lost more than 2 Snellen lines. Kirwan et al. (7) however noticed that VA remained constant for most of their pediatric patients.
Additional experience will better define the indications and scope of diode laser cyclodestruction (1).

CONCLUSIONS

Although our number of patients is small, this study indicates that diode laser cyclodestruction is a reasonably safe procedure that can lower the IOP significantly in the long-term in patients with refractory glaucoma. It seems that it is not an efficient procedure to reduce the IOP to less than 17 mmHg.

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