Coll. Antropol. **25** Suppl. (2001) 111–115
UDC 617.749-089.844
Professional paper

Intraocular Pressure Reduction after Selective Laser Trabeculoplasty in Primary Open Angle Glaucoma

T. Gračner

General Hospital Maribor, Department of Ophthalmology, Maribor, Slovenia

A B S T R A C T

The aim of this prospective clinical study was to investigate the intraocular pressure (IOP) reduction after selective laser trabeculoplasty (SLT) in patients with primary open-angle glaucoma (POAG). SLT represents a new method in the treatment of POAG. Fifty eyes with uncontrolled POAG were treated with a frequency doubled, Q-switched Nd:YAG laser (532 nm). The pattern of treatment was applying approximately 50 burns to 180 degrees of the trabecular meshwork at energy levels ranging from 0.40– 0.92 mJ per pulse. After SLT eyes were maintained with the identical hypotensive medical therapy as that before treatment. IOP was measured before treatment, 1 and 7 days after treatment and 1, 3, 6 and 12 months after treatment. The mean pretreatment IOP was 22.48 (SD 1.84) mm Hg. At the end of 1 month follow-up period the mean reduction of IOP was 4.86 (SD 2.38) mmHg or 21.6%; after 3 months the mean reduction was 5.66 (SD 2.40) mmHg or 25.2%; after 6 months the mean reduction of IOP was 5.06 (SD 2.37) mmHg or 22.5%; at the end of 12 months follow-up period the mean reduction was 4.92 (SD 2.58) mmHg or 21.9%. It can be concluded that SLT presents a new and effective method of IOP reduction in the treatment of POAG.

Introduction

Selective laser trabeculoplasty (SLT) is a new laser procedure that selectively targets the pigmented trabecular meshwork (TM) cells without causing thermal damage or collateral damage to nonpigmented cells or structures[1]. For SLT a 532-nm Q-switched frequency doubled Nd:YAG laser is used. The precise mechanism of action of SLT is unknown. Disruption or killing of pigmented TM cells alone appears to induce a response that results in a reduction of IOP in this procedure[2]. Following the results of clinical studies SLT appears to be a safe and effective method of lowering the IOP in eyes with primary open-angle glaucoma (POAG)[2–5]. The aim of our prospective clinical study was to investigate the IOP

Received for publication June 4, 2001.

reduction after SLT in the treatment of uncontrolled POAG in patients followed for 12 months.

Materials and Methods

Patients included in this clinical study had POAG for which medical therapy had failed to satisfactorily control intraocular pressure (> 18 mmHg). All eyes were treated with SLT. The IOP was measured with a Goldmann applanation tonometer at least three times in 4 weeks before laser treatment was performed. The mean preoperative IOPs was used as the baseline IOP. On the day of SLT, IOP was measured and one drop of 0.5% apraclonidine was instilled in the study eye one hour before treatment. A 532-nm frequency doubled Q-switched Nd:YAG laser (Selecta 7000, Coherent, Palo Alto, CA, USA) was applied to the inferior 180° of the TM of each eye. The pulse duration was 3 ns and the laser spot size was 400 µm. Treatment was conducted with adjacent but not overlapping spots. The mean number of applied burns was 49.6 (range 47–53). The initial energy used was 0.8 mJ. The energy was increased or decreased until bubble formation appeared and was then decreased by 0.1 mJ for the rest of the treatment. Energies ranged from 0.40 mJ to 0.94 mJ with the mean energy of 0.68 mJ for each spot. A drop of 0.5% apraclonidine was instilled in all post-laser eyes. Dexamethasone-Neomycine eye drops were prescribed after treatment four times a day for 7 days. Post-treatment evaluation consisted of a slit lamp examination and applanation tonometry performed 1 and 3 hours, 1 and 7 days, 1, 3, 6 and 12 months after treatment. Hypotensive medical therapy was not modified during 12 months follow-up period. For statistical analyses of the results, the paired t-test was used.

Results

Fifty eyes of 28 patients were treated with SLT. Twenty-one were females (75%) and 7 (25%) were males. The mean age was 71 years (range 50–84). The average number of hypotensive medications at baseline and 12 months after treatment was 2.6 (range 2–4). The baseline IOP was 22.48 mmHg (range 18–26). The mean IOPs, mean IOP reduction and percent IOP reduction from baseline IOP 1 day, 7 days, 1 month, 3 months, 6 months and 12 months after treatment are listed in Table 1. The greatest decrease in IOP occurred 3 months (25.2%) after the procedure. At the end of 12 months follow-up period the mean reduction of IOP was 4.92 (SD 2.58). In percentage the IOP reduction from baseline in all treated eyes was 21.9%.

TABLE 1
MEAN IOP, MEAN IOP REDUCTION AND PERCENT IOP REDUCTION FROM BASELINE IOP AT 1 AND 7 DAYS, 1, 3, 6 AND 12 MONTHS AFTER TREATMENT

Follow-up time	Mean IOP /SD/ (mmHg)	Mean IOP reduction /SD/ (mmHg)	P	IOP reduction (%)
Baseline IOP	22.48 /1.84/	–	–	–
1 day	17.36 /2.59/	5.12 /3.08/	< 0.0001	22.8
7 days	18.44 /2.57/	4.04 /2.61/	< 0.0001	18.0
1 month	17.62 /2.05/	4.86 /2.38/	< 0.0001	21.6
3 months	16.82 /2.21/	5.66 /2.40/	< 0.0001	25.2
6 months	17.42 /1.90/	5.06 /2.37/	< 0.0001	22.5
12 months	17.56 /2.26/	4.92 /2.58/	< 0.0001	21.9

The absolute IOP reductions from baseline at 3 months following treatment are listed in Table 2, at 6 months in Table 3 and at 12 months in Table 4. An absolute IOP reduction of 3 mmHg or greater was achieved in 92% of eyes at 3 months, in 88% of eyes at 6 months and in 86% of eyes at 12 months following treatment. A transient increase in IOP for 1 mmHg 1 hour after treatment occurred in 3 eyes and for 3 mmHg in 1 eye (2%). Three hours after treatment a transient increase of 2 mmHg occurred in 3 eyes (6%) and of 4 mmHg in 1 eye (2%) for. The IOP elevations were not treated with additional antiglaucoma medications and resolved in all cases within 12 hours. Significant anterior segment inflammation was not detected after SLT in any of the eyes. None of the patients complained of pain or any discomfort during treatment.

TABLE 2
ABSOLUTE IOP REDUCTION FROM BASELINE AT 3 MONTHS

IOP Reduction (mmHg from baseline)	n = 50	%
0–2	4	8
3–6	30	60
7–10	15	30
11–13	1	2

TABLE 3
ABSOLUTE IOP REDUCTION FROM BASELINE AT 6 MONTHS

IOP Reduction (mmHg from baseline)	n = 50	%
0–2	6	12
3–6	30	60
7–10	14	28

TABLE 4
ABSOLUTE IOP REDUCTION FROM BASELINE AT 12 MONTHS

IOP Reduction (mmHg from baseline)	n = 50	%
0–2	7	14
3–6	26	52
7–10	16	32
11–13	1	2

Discussion

Laser treatment of TM known as laser trabeculoplasty is a commonly accepted intervention in the management of open angle glaucoma. Different types of lasers with various wavelengths are used for laser trabeculoplasty. Most commonly used laser unit for trabeculoplasty is a continuous-wave argon laser (454.5–528.7 nm). It has been in use since 1979. when the first successful protocol of argon laser trabeculoplasty was described[6]. Trabeculoplasty can also be performed with krypton red and yellow lasers[7], Q-switched ruby laser[8], continuous wave neodymium (Nd):YAG laser[9], and diode laser[10].

Recently, a new approach to laser treatment of TM by selectively targeting pigmented TM cells without causing thermal damage or collateral damage to nonpigmented cells or structures and thus maintain the architecture of the TM was presented and termed SLT[1]. For SLT a 532-nm Q-switched frequency doubled Nd:YAG laser with a single pulse of short duration (in the microsecond range) and low fluency (energy/area) is used[1]. The precise mechanism of action for the pressure lowering effect of SLT is unknown. Acute morphological changes evaluated by electron microscopy in human postmortem eyes treated with SLT showed no evidence of coagulative damage and minimal evidence of mechanical damage to human TM[11]. However, since minimal mechanical damage is thought to occur, a predominately cellular theory, as the mechanism of action, has been proposed to explain an improvement in outflow facility in eyes treated with SLT[2]. Thus, a

Q-switched Nd:YAG laser for SLT in the clinical practice was proposed as a new laser treatment for POAG[11].

In our prospective clinical study we investigated the IOP reduction after SLT treatment in 50 eyes with uncontrolled POAG. We found that the IOP reduction after SLT is achieved immediately – 1 day after treatment, with the mean IOP reduction of 5.12 mmHg (22.8%) from the baseline pretreatment level in all treated eyes. After 6 months follow-up the IOP reduction from baseline in all treated eyes was 5.06 mmHg (22.5%). After 12 months follow-up the IOP reduction from the baseline in all treated eyes remained stable and was 4.92 mmHg (21.9%). We also found, that the absolute IOP reduction of 3 mmHg or greater was achieved in 92% of eyes at 3 months after treatment and in 88% of eyes at 6 months after treatment. At 12 months after treatment 86% of eyes achieved an absolute IOP reduction of 3 mmHg. These results are comparable with the results of Latina et al[2], who, in their prospective clinical trial with 53 uncontrolled POAG eyes after SLT, reported the absolute IOP reduction of 3 mmHg or greater in 70% of treated eyes and after the follow-up period of 6 months in 44 eyes the mean IOP reduction of 4.6 mmHg (18.7%). Damji et al[4] reported the mean IOP reduction of 4.8 mmHg after the follow-up period of 6 months in 18 eyes with uncontrolled POAG after treatment with SLT. Kaulen et al[5] studied a larger number of treated eyes – 224 eyes with uncontrolled POAG treated with SLT. The follow-up period was 10 months (range 1–20) and the mean IOP reduction was 6 mmHg (23%). In the study of Latina et al[2] an increase in IOP 2 hours after treatment for 5 mmHg or greater was detected in 18 eyes (34%) and the anterior segment inflammation in 44 eyes (83%). Lanzetta et al[3] detected in only one eye (12.5%) 1 hour after treatment an increase of IOP greater than 5 mmHg, without any significant anterior segment inflammation. In those two studies pre- and posttreatment eyes were not on medication regimen of 0.5 % apraclonidine and the energy levels ranged from 0.6 to 1.2 mJ per pulse. Damji et al[4] detected significant anterior segment inflammation after treatment with no posttreatment IOP elevations. 1-% apraclonidine pre- and posttreatment was used and the energy levels ranged from 0.8 to 1.4 mJ per pulse.

In our study the transient IOP increase 1 to 3 hours after treatment was not significant. It occurred in 8 eyes (16%) and was not greater than 4 mmHg. Significant anterior segment inflammation after SLT was not detected. We think this is a result of pre- and posttreatment use of one drop of 0.5% apraclonidine and low energies used: between 0.40 and 0.94 mJ with the mean energy of 0.68 mJ for each spot.

The results of our study proved SLT to be an effective and safe method for IOP reduction in the treatment of POAG. To investigate the duration of IOP lowering effect we need a long-term follow-up prospective clinical study.

REFERENCES

1. LATINA, M. A., C. PARK, Exp Eye Res 60 (1995) 359. — 2. LATINA, M. A., S. A. SIBAYAN, D. H. SHIN, R. J. NOECKER, G. MARCELLINO, Ophthalmology 105 (1998) 2082. — 3. LANZETTA, P., U. MENCHINI, G. VIRGILI, Br J Ophthalmol 83 (1999) 29. — 4. DAMJI, K. F., K. C. SHAH, W. J. ROCK, H. S. BAINS, W. G. HODGE, Br J Ophthalmol 83 (1999) 718. — 5. KAULEN, P., A. RICHTER, C. WIEMER, Klin Monatsbl Augenheilkd 213 (1998) S12. — 6. WISE, J. B., S. L. WITTER, Arch Ophthalmol 97 (1979) 319. — 7. SPURNY, R. C., C. M. Jr. LEDERER, Arch Ophthalmol 102 (1984) 1626. — 8. ROBIN, A. L

., I. P. POLLACK, Ophthalmology 91 (1984) 366. — 9. BELGRADO, G., M. B. VAN GEERTRUYDEN, R. HERZEEL: Comparison of argon and cw Nd:YAG laser trabeculoplasty, Clinical results. In: MARSHALL, J. ed.: Laser technology in ophthalmology. (Berkeley: Amsterdam; Kugler & Ghedini, 1988) 45. — 10. MCHUGH, D., J. MARSHALL, T. J. FFYTCHE, Br J Ophthalmol 74 (1990) 743. — 11. NOECKER, R. J., T. R. KRAMER, M. A. LATINA, Invest Ophthalmol Vis Sci 39 (1998)S 472.

T. Gračner

General Hospital Maribor, Department of Ophthalmology, Ljubljanska 5, 2000 Maribor, Slovenija

SMANJENJE INTRAOKULARNOG TLAKA NAKON SELEKTIVNE LASERSKE TRABEKULOPLASTIKE KOD PRIMARNOG GLAUKOMA OTVORENOG KUTA – 12-MJESEČNO PRAĆENJE

S A Ž E T A K

Cilj ovog istraživanja bio je ispitati smanjenje intraokularnog tlaka nakon selektivne laserske trabekuloplastike (SLT) kod pacijenata s primarnim glaukomom otvorenog kuta (POAG) u prospektivnoj kliničkoj studiji. SLT predstavlja novu metodu u liječenju primarnog glaukoma otvorenog kuta. Pedeset očiju s nekontroliranim primarnim glaukomom otvorenog kuta tretirano je dvostrukofrekventno »Q-switched« Nd-YAG laserom (532 nm). Ukupan broj od oko 50 nepreklapajućih spotova energetske razine u rasponu od 0.40 do 0.92 mJ po pulsu aplicirano je na 180 stupnjeva trabekularnog aparata. Nakon SLT-a primjenjivana je istovjetna medikamentna hipotenzivna terapija kao i prije zahvata. Intraokularni tlak mjeren je prije tretmana, te nakon 1 i 7 dana, te 1,3,6 i 12 mjeseci. Srednja vrijednost intraokularnog tlaka prije zahvata iznosila je 22.48 (SD 1.84) mmHg. Na kraju prvog mjeseca praćenja vrijednost intraokularnog tlaka smanjila se u prosjeku za 4.86 (SD 2.38) mmHg ili 21.6%; nakon 3 mjeseca za prosječno 5.66 (SD 2.40) mmHg ili 25.2%; nakon 6 mjeseci za prosječno 5.06 (SD 2.37) mmHg ili 22.5% te na kraju 12-mjesečnog perioda praćenja za 4.92 (SD 2.58) mmHg ili 21.9%. Možemo zaključiti da SLT predstavlja novu djelotvornu metodu za smanjenje intraokularnog tlaka u liječenju primarnog glaukoma otvorenog kuta.