

Intraocular pressure rise after argon laser trabeculoplasty

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SUMMARY Eighty-four eyes received 107 argon laser trabeculoplasty treatments at Beth Israel Medical Center between 1982 and 1984 for advanced primary and secondary glaucoma. The prelaser mean pressure was 20.25 mmHg. Pressures taken 1½ hours postoperatively varied widely: the pressure rose after 47 treatments and fell or remained the same after 60. Significant increases in pressure occurred in 10 eyes, after 12 treatments; 42% of these had received burns of 0.8 watts or greater. Pressure changes were correlated with laser burn energy level. Both patients who had significant increases in pressure initially were retreated again—in the same eye—at another time had similar increases in postoperative pressure again, even with lower energy levels. Comparison with the results of previous reports highlights the advantages of limited treatment to the anterior trabeculum with low energy levels.

Laser trabeculoplasty (LTP) is of benefit to patients on maximum medical therapy whose condition is considered to be out of control. Laser therapy may allow the withdrawal of systemic or topical agents and sometimes postpone invasive surgical filtering procedures. The ability of LTP to lower intraocular pressure has gained it wide acceptance as a surgical alternative. While long term results are not clearly defined, the effects of LTP may be lessened by short term complications that include iritis, peripheral anterior synechiae, and visual field loss.¹

An immediate postoperative rise in intraocular pressure has been recognised as a serious complication of LTP, since candidates for the procedure belong, by definition, to a group particularly susceptible to pressure elevations. Some investigators have attributed loss of field and central vision to these transient pressure rises.² It has been suggested that these pressure elevations are related to the placement, extent, number, and configuration of burns on the trabecular meshwork as well as to their energy level. The limitation of treatment to half of the angle was originally conceived in an attempt to avoid such acute pressure changes.

Material and methods

Between June 1982 and June 1984, 84 eyes of 59 patients were treated at the Beth Israel Medical Center for advanced primary and secondary glaucoma. Twenty-three eyes were retreated: 107 treatments were made in all. The mean age of the patients was 69.5 years, range 50 to 86. Seventy-five treatments were given to eyes with uncontrolled chronic open angle glaucoma (Table 1). Patients previously operated on and with secondary glaucomas were not excluded. All patients had marked damage of the optic nerve and advanced visual field loss. All were receiving the maximum tolerated medical therapy and were candidates for filtration surgery or other surgical intervention. The standard preoperative medical regimen included a miotic (pilocarpine or carbachol), epinephrine or propine, timolol, and a carbonic anhydrase inhibitor (either acetazolamide or methazolamide). In seven

Table 1 *Diagnosis of eyes treated*

Chronic open angle glaucoma	67
Pigmentary glaucoma	4
Low tension glaucoma	6
Pseudoexfoliation glaucoma	6
Glaucoma secondary to uveitis	1

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cases laser surgery was performed because patients could not tolerate maximum medical therapy with side effects from miotics, carbonic anhydrase inhibitors, or beta blockers. Twenty-eight patients were male, 31 were female, and all were white. However, all the eyes treated by argon laser had pilocarpine 3% or carbachol 1.5% eye drops instilled immediately prior to laser treatment.

Surgery was performed on all patients by ML using a Coherent System 900 Argon laser photocoagulator. The patient was seated at the slit-lamp and a drop of topical tetracaine instilled. An antireflective-coated Goldmann three-mirror lens was placed on the eye with methylcellulose. The duration of exposure was 0.1 second, and burns were spaced evenly over the anterior half of 180° of the trabecular meshwork with a spot size of 50 µm. Power was titrated to a minimum on the basis of patient reaction. The criterion for the proper burn was blanching of meshwork. The mean laser power setting was 0.67 watt. Power output at the slit-lamp measured 90 to 95% of the meter readings as measured by external output meter calibrated for the Coherent Argon Laser and Zeiss slit-lamp and supplied by Coherent. The actual laser power administered was therefore minimally lower than the setting indicated. The number of spots varied from 50 to 55, and the mean calculated energy delivered was 3.6 joules (range of 3.0 to 6.25, standard deviation 1.7). Gonioplasty was performed as a preliminary procedure in seven patients: large 200 µm burns of 1.5 watts were applied to the peripheral iris, widening the inlet and helping to bring the meshwork into view.

The intraocular pressure (IOP) was determined for both eyes before the laser treatment. Postoperative monitoring was undertaken at one and one half hours and again later that day if a rise was found. All pressures were measured by Goldmann applanation tonometer with the patient seated at the slit-lamp. Excessive intraocular pressure was reduced with orally administered 50% glycerol, 2 ml per kilogram body weight. All preoperative glaucoma medications were continued in the postoperative period. Steroids were not used. Change in pressure was calculated by subtraction from preoperative pressure as measured on that day.

Following the suggestion made by Krupin *et al.*² a significant pressure rise was defined as either (1) an increase of 30% over prelaser pressure as taken that day, (2) a final pressure of greater than 30 mmHg, or (3) an increase of greater than 10 mmHg over preoperative pressure levels. Krupin *et al.*² used 'peak prelaser diurnal curve' IOP taken on another day as the baseline IOP measurement. We consider this to be not as relevant as the immediately preoperative pressure, which constituted our baseline

IOP pressure. This may have increased the number of cases considered significant in our series compared with theirs. Further, we considered our IOP rise to be significant if any one of our criteria were met, whereas Krupin *et al.* required that they all be met, namely, an increase of 30% over preoperative IOP, a rise to over 30 mmHg, and any increase of 10 mmHg over preoperative diurnal peak. Those cases of low tension glaucoma with a rise of 15 mmHg or more would not be included under such a definition unless they reached 30, despite the possible real risk to the patient. We considered that a low tension patient with a preoperative IOP of 10 or 15 mmHg was at risk if pressure rose to 29 mmHg despite the fact that the final pressure, for a chronic glaucoma patient, would not seem so great.

Results

The mean prelaser pressure was 20.25 mmHg (SD 6.2). One and a half hours after surgery the pressure was noted to rise in 47 (44%) cases. The pressure fell or remained the same in 60 cases. Pressure changes ranged from -7 mmHg to +30 mmHg. Twelve treatments (11.2%) resulted in significant pressure increases as defined by our criteria. Ten eyes and nine patients were involved. The average age of this group was 71.7 years (SD 7.8); five patients were male, four were female. Eight of nine had chronic open angle glaucoma, while one patient had glaucoma secondary to uveitis. The average laser power used in these 10 eyes was 0.81 watt (range 0.6 to 1.25, SD 0.21), compared with an average of 0.64 watt for all other patients (range 0.45 to 1.2, SD 0.24). Of the 12 total treatments in the study that used a laser power of 0.8 watt or greater, five (42%) resulted in significant rises in pressure. In contrast, of the 95 treatments using burns under 0.8 watt, only seven (7.3%) caused such a rise.

Of the four patients in the group of significant responders who had both eyes treated one had a bilateral pressure rise, while three had a high pressure rise in one eye only.

Three patients in the group of significant responders received two treatments to the same eye. Both of the patients who had an increased intraocular pressure on the first treatment suffered it again on retreatment. The other patient, who lacked such a response the first time, developed it only on second treatment to that eye.

Finally, among the 12 patients with high pressure response one eye had concurrent gonioplasty. An elevated pressure thus resulted in one of the seven patients with gonioplasty.

Twenty-three of the 84 eyes were retreated with a second LTP. Eighteen of these had chronic open

angle glaucoma, while one had pigmentary glaucoma and one pseudoexfoliation. Three had low tension glaucoma and one was aphakic. Two experienced pressure rises on both treatments, one only on the repeat treatment. No significant pressure rise was detected in any of the eyes with pigmentary (5), aphakic (4), low tension (9), or pseudoexfoliative (7) glaucoma.

Significant pressure rise was not linked to age, sex, or eye treated.

The long term results of laser treatment are found elsewhere. Response did not correlate with the occurrence of an early postoperative increase in pressure, as has been suggested by Weinreb *et al.*³ Of the 10 eyes and 12 treatments with a significant pressure rise six had successful results (from three to 12 months' follow-up), two eyes came to trabeculectomy, and two were lost to follow-up (Harrison R, Luntz M H, personal communication, paper in preparation). Of the nine failures in our total of 84 eyes two had significant intraocular pressure responses, and this occurred in 11% of successful cases.

Discussion

The risks of intraocular pressure rise immediately after laser trabeculoplasty have been highlighted earlier and are confirmed in this study. Previous suggestions for decreasing the danger of the response have included treating anteriorly, reducing the number and power of burns, and limiting treatment to one half or even one quarter of the meshwork.⁴ Treatments thus limited still result in increases of pressure. This study confirms the importance of technique and energy levels, with an incidence of significant pressure rises comparable to that of other studies done in a similar manner, and suggests that eyes sensitive to LTP will respond with intraocular pressure increases in a consistent manner on repeat treatment, which should therefore be undertaken with caution.

Wilensky and Weinreb⁵ demonstrated that a pressure rise occurs most often three to five hours postoperatively when the entire meshwork is treated, while it occurs earlier, at one and one half hours, if half of the entire angle is lasered. This was the time of pressure check in our series. In their series of 57 patients Krupin *et al.*² had two patients with significant pressure rises at four and seven hours that would have been missed when monitoring in the first hour only. It is clear that sensitive individuals at risk for central field loss would best be served by following pressure rise from 1.5 hours to seven hours after LTP.

Previous studies recording intraocular pressure

rise following LTP have varied according to definition and timing of recording pressure elevations, but still allow a suitable comparison with our own, especially with regard to techniques used. Weinreb *et al.*,³ comparing different treatments, found that when using 360° anterior treatments of 0.8 watt, 10 out of 20 (50%) of eyes responded with a 'corrected' pressure change of +10 or greater. Using 180° treatment they found only one out of 20 (5%) to have such a change. It should be noted that this corrected definition tends to minimise change by subtracting rises occurring simultaneously in the other eye.

Hoskins *et al.* found 21 of 106 (19.8%) eyes to have an uncorrected pressure rise of greater than or equal to 10 mmHg. Their techniques varied within the study, divided between 180° and 360° burns as well as both anterior and posterior placement. They did note that the number of pressure rises was 9% if fewer than 65 burns were made and 29% if more were used.¹

Thomas *et al.* found that with 180° treatment 11.5% had pressure elevations greater than or equal to 10 mmHg above the baseline, compared with 37% with 360° treatment. These figures were accumulated over a three-week period however.⁶ Krupin *et al.*, including readings taken at four, seven, nine, and 20 hours as well, found that 14% had significant pressure elevations by their criteria.² Had their readings been made only at one hour the percentage would have been slightly lower.

Admittedly the time of comparison, power, and techniques have varied, but studies seem consistent in finding one range of risk when treating the entire angle and another lower range when treating half the angle. Despite differing definitions of the significant, our figure of 11.2% compares closely with other 180° treatments by Krupin *et al.* (14%), Weinreb *et al.* (11.5%), and Hoskins *et al.* (9%). Unlike the consistency in reports on the frequency of significant pressure increases, there is considerable variation among studies of the number of eyes showing intraocular pressure increases of more modest proportions. An increase of IOP of any magnitude was found in 25.3% by Thomas *et al.*, 34% by Hoskins *et al.*, 53% by Krupin *et al.*, and 35% by Weinreb *et al.* using 180° and 70% using 360°. Our finding of 47% falls near the average of these studies. It would appear that this number in itself is of little importance, and attention should be paid to large increases with potential damage to the eye.

Weinreb *et al.*³ considered that there was no reduction in the long term success of LTP with 180° treatments and also argued that results may suffer in the presence of acute postoperative pressure rises. It would appear that the final outcome in our study was not tied to the pressure elevation.

Less argon laser power was used in this study than described in other reports. Wise and Witter used 100 or 120 burns with 1.0 to 1.5 watts.⁷ While Krupin *et al.*² used anterior treatments and low powers similar to ours, with results comparable to our own, they did not demonstrate within the study of their own patients a correlation between power and pressure rise. In this series there was a significant correlation. Treatments using greater than or equal to 0.8 watt of power made up only 11.2% of the total number of treatments, yet were implicated in 42%, or 5 of the 12 treatments, with a significant pressure rise. The average laser power for responders was 0.78 watt compared with 0.64 for those not responding with a pressure rise. 42% of patients with treated energy ≥ 0.8 watt had a significant rise as opposed to 7.3% of those treated with < 0.8 watt.

Those who responded with a high pressure rise to one application did so again on repeat treatment, even when that second treatment was done at a lower energy level. The converse is not so: lack of a rise on initial treatment does not preclude its occurrence on retreatment. Similar statements cannot be made about the treatment of second eyes: only one out of four patients in the significant responders group who were treated bilaterally, had bilateral elevations.

In sum, patients should be followed up carefully after laser trabeculoplasty for immediate intraocular pressure increases. In an attempt to limit the extent of these increases we consider treatments are best maintained as close to 0.8 watt as possible. If higher levels are to be used, the prophylactic lowering of pressure preoperatively would seem to be advisable, especially in patients with field loss threatening fixation who are at high risk for further sudden optic nerve damage. It should be recalled, however, that Hoskins *et al.* found that pretreatment with acetazolamide did not diminish the intraocular

pressure rise, and other agents should be considered.¹

While flurbiprofen and prednisolone acetate 1% have not proved of great value in preventing pressure rise,^{8,9} attempts at varying concentrations of prostaglandin inhibitors to achieve an effect have been made. Richardson has suggested that frequent pilocarpine administration following LTP, 2% or 4% every two hours during the next 24 hours, may affect IOP rises.¹⁰ Since these patients are usually already on full medication, one wonders how the addition of these drops can be effective.

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