

Efficacy of Argon Laser Trabeculoplasty in Lowering Intraocular Pressure as Adjunctive Treatment In Primary Open Angle Glaucoma

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Purpose: To assess efficacy and safety of argon laser trabeculoplasty (ALT) to lower intra ocular pressure (IOP) as adjunctive treatment in primary open angle glaucoma (POAG) patients.

Study Design: Descriptive Cross Sectional.

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Place and Duration of Study: Ophthalmology Department, Abbassi Shaheed Hospital from May 2016 to August, 2017.

Materials and Methods: Primary open glaucoma patients were selected from eye OPD. Patients with Inflammatory, angle closure, traumatic glaucoma were excluded. Pre laser and Post laser IOP was measured at 1st week then at 1, 3 and 6 months. Data was collected and analyzed on SPSS version 20. There were 114 patients. Sample size was calculated by Rao Soft Sample size calculator.

Results: A total of 114 patients were included in the study. There were 69 (61%) male patients. Mean age of patients was 60.53 ± 10.71 years. Mean pre laser Intraocular pressure was 23.98 ± 10.01 mm Hg. Mean post laser IOP at one month was 15.6 ± 3.25 and at 6 months was 14.8 ± 3.28 mm Hg. Overall mean reduction of IOP was 9.18 mm Hg from baseline, with p value less than < 0.005 . Pre laser 3 medications were used by 20 (18%) and 2 medications by 49 (43%). At 6 months follow-up 4 (3.5%) patients were on 3 medications and 31 (37%) were on 2 medications. It has a p value < 0.005 .

Drug free patients at 6 months follow-up were 37 (33%). Mild iritis was seen in 7 (6.14%) patients.

Conclusion: Argon Laser Trabeculoplasty is effective and safe method to control IOP in POAG when used as an adjunct to medical therapy.

Key Words: Argon laser trabeculoplasty, intraocular pressure, primary open angle glaucoma.

Glaucoma is the leading cause of irreversible blindness world over. It is estimated that 64 million people suffer from this disease around the world¹. It is characterized by optic nerve damage, cupping of the optic disc and typical visual field defects. Rise in intra ocular pressure is a major risk factor. Reduction of intraocular pressure (IOP) may be helpful in reducing the optic nerve damage². It is the third leading cause of irreversible blindness over the age of 40 years in Pakistan³.

Primary open angle glaucoma (POAG) commonly presents in our clinics where the cause of raised intraocular pressure is functional impairment of trabecular meshwork (TM). Medical treatment is the first line of treatment. Surgical treatment is generally offered when patient does not respond to medical treatment. Wise and Witter are credited for describing first successful protocol, which is widely known as Laser Trabeculoplasty (LTP) in 1979⁴.

The utilized energy source for modern LTP is continuous-wave argon laser, operated in the blue-green wavelength spectrum (454-529 nm)⁵. The exact mechanism of the procedure is not known, but it is believed that the laser energy applied to the trabecular meshwork initiates structural and/or physiologic changes that facilitate aqueous outflow⁶.

Wise and Witter stated that thermal energy produced by pigment absorption of laser light causes fibrosis of collagen in trabecular lamellae. Subsequent shortening of treated meshwork might enlarge existing spaces between two treatment sites and expands Schlemm's canal by pulling meshwork centrally which facilitates the aqueous drainage from the trabecular meshwork^{4,7}.

Microscopic and immune histochemical analysis of the trabecular meshwork after ALT has shown local photocoagulation of treated trabecular tissue, while

cells adjacent to treated areas have shown increased phagocytic activity.

Moreover studies have reported changes in the extracellular matrix after LTP related to an induction of matrix metalloproteinases. These enzymes normally break down extracellular matrix to maintain normal turnover of trabecular meshwork. Thus there is cellular activation of trabecular mesh work with increased trabecular cell replication and increased number of cells involved in maintaining the outflow from trabecular meshwork⁸.

Laser trabeculoplasty (LTP) is a well known therapeutic method for the management of glaucoma since the last 30 years, which became popular during the past 10 years. LTP is an effective therapeutic option, as it can supplement topical medical treatment. One laser session can reduce the Intraocular pressure (IOP) for many years, thus reducing the adverse effects of poor compliance associated with medical treatment. More over LTP is in general a well tolerated and usually a low-risk procedure, as compared with glaucoma surgery⁵.

Majority of patients coming to government hospitals belong to poor socioeconomic class with poor compliance. This procedure will be safe and cost effective in lowering intraocular pressure. It will also decrease number of topical anti glaucoma medication which are a financial burden for them. Little work has been published on this topic in local journals. We conducted this study to assess efficacy and safety of argon laser trabeculoplasty to lower intra ocular pressure as adjunctive treatment in patients with primary open angle glaucoma.

MATERIALS AND METHODS

The study was carried out at ophthalmology department Abbasi Shaheed Hospital and Karachi

Medical & Dental College from May 2016 to August 2017. It was a descriptive cross sectional study. It was started after approval from Ethical Review Committee of the hospital. Informed consent was taken. Patients were registered through non probability consecutive sampling technique. Sample size was calculated using Rao Soft Sample Size calculator taking confidence interval 90%, Margin of error 5%, population size 10,000 and prevalence P for reduction in intraocular pressure 12.1 mm Hg from the reference study.⁹ Calculated sample size was 114.

Patients 45 years of age or above, diagnosed with Primary open angle glaucoma with failed medical treatment were included in the study. Patients with angle closure glaucoma, inflammatory glaucoma, traumatic glaucoma, aphakic and pseudophakic glaucoma and those having history of previous trabeculectomy and cataract surgery were excluded from the study.

Written informed consent was taken from them. Detail history was taken. Ocular examination was conducted including visual acuity, slit lamp examination, intraocular pressure, gonioscopy and funduscopy. Diagnosis of Primary open glaucoma was established after ocular examination, optical coherence tomography and visual fields.

These patients underwent laser trabeculoplasty under topical anaesthesia. Pressure lowering agents Brimonidine and Pilocarpine were instilled 1 hour before surgery. A Goldmann 3-mirror gonioscope was placed on the eye with 1% methylcellulose. The helium-neon aiming beam was focused at the junction of pigmented and non pigmented trabecular meshwork with a spot size of 50 microns and duration of 0.1 seconds, keeping the starting energy level at 200 watts and increased according to the level of TM pigmentation. Blanching of the TM or bubble formation was taken as the end result. Approximately 50 adjacent laser spots were applied over inferior 180° of the TM, 25 spots in each quadrant.

Post laser IOP was measured at one hour, one day, one week, and one, three, and six months. These responses were recorded on predesigned performa. During the post laser follow-up period, patients were treated with mild steroid (flouromethalone) 4 times a day which was withdrawn after 1 week, topical nonsteroidal anti-inflammatory drug (nepafenac) 3 times a day which was continued for 1 month and topical antiglaucoma medications as required. Progression of glaucoma was monitored by visual

fields and OCT (Optical coherence tomography) throughout the study.

Data was collected and analyzed on SPSS version 20. Means were computed for numerical variables like age, pre-laser intraocular pressure and post laser intraocular pressure with standard deviations. Frequencies of gender, eye, systemic diseases, visual acuity, pre-laser and post laser medications were calculated. A paired t test was used for assessing changes in IOP at different follow up visits. Reduction

in number of topical medications pre laser and post laser treatment was assessed with help of pair t test. P value of less than 0.05 was taken as statistically significant.

RESULTS

A total of 114 patients were included in our study. Out of these male patients were (69) 61%. Mean age of the patients was 60.53 ± 10.71 SD years ranging from 45 to 82 years. Right eye was treated in 54 (47%) patients and left eye was treated in 60 (53%) patients. All other demographic features of patients are given in Table 1. Mean pre laser IOP was 23.98 ± 10.01 SD mm Hg. Mean IOP at day one post laser was 15.7 ± 3.68 SD mm Hg. Mean IOP at one month post laser follow up was

15.6 ± 3.25 SD mm Hg. Mean IOP at 3 and 6 months post laser follow up visit was 14.8 ± 2.61 SD mm Hg and 14.8 ± 3.28 SD mm Hg respectively. There was an overall mean reduction of 9.18 mm Hg from baseline which was statistically significant (Table 2). Pre laser patients on 3 medications were 20 (18%) and those on 2 medications were 49 (43%) while at 3 months follow up 4 (3.5%) patients were on 3 medications and 39 (34%) were on 2 medications. At 6 months follow-up 4 (3.5%) patients were on 3 medications and 31 (37%) patients were on 2 medications (Table 3). This reduction in medications was statistically significant with p value < 0.005. Drug free patients at 6 months follow up were 37 (33%) (Table 1). No significant post laser complications were seen except mild iritis in 7 (6.14%)

Table 1: Demographic Characteristics.

Variables	Frequencies	Percentages
Mean Age in years	60.53 ± 10.71 SD	
Minimum	45	
maximum	82	
Gender		
Male	69	61%
Right eye	54	47%
Left eye	60	53%
Duration of glaucoma (mean) years	6 ± 3.6 years	
Visual acuity		
6/6 -6/9	21	18.4%
6/12- 6/18	18	16%
6/24- 6/60	41	36%
Less than 6/60	34	30%
Systemic disease		
HTN	15	13%
DM	7	6%
Both eyes	78	68.4%
Drug free at 6 months post laser	37	33%

Table 2: Post ALT Reduction in IOP.

No.	IOP	Mean IOP \pm SD mmhg	Comparison	P value
1.	Pre laser	23.98 ± 10.01		
2.	1 day	15.7 ± 3.68	1 & 2	< .000
3.	1 month	15.6 ± 3.25	1 & 3	< .000
4.	3 months	14.8 ± 2.61	1 & 4	< .000
5.	6 months	14.8 ± 3.28	1 & 5	< .000

patients and transient rise in IOP in 2 (1.75%) patients which were managed with topical steroids and pressure lowering agents.

Table 3: Post ALT Reduction in Medications.

	Frequency	%
Pre laser medication		
1 medication	25	22%
2 medications	49	43%
3 medications	20	18%

4 medications	20	18%
Post laser 3 month		
1 medication	45	40%
2 medications	39	34%
3 medications	4	3.5%
4 medications	0	
Post laser 6 month		
1 medications	38	33%
2 medications	35	31%
3 medications	4	3.5%
4 medications	0	

Table 4: Pair-T Test.

No.	No of Medications	P value
1.	Prelaser medications & at 3 month	< .000
2.	Prelaser medication & at 6 month	< .000

Pair T test was conducted to evaluate the effect of Argon laser trabeculoplasty on intra ocular pressure. There was a significant difference in mean pre laser IOP (23.98 ± 10.01 mm Hg SD) and 1 month post laser IOP (15.5 ± 3.2 mm Hg SD) with 95% CI ranging from 6.66 to 10.1 with p value of less than 0.005. Three month post laser mean IOP was 14.8 ± 2.61 SD mm Hg with 95% CI ranging from 7.4 to 10.8 and P value of less than .005. Six month post laser mean IOP was 14.8 ± 3.2 mm Hg SD with 95% CI ranging from 7.4 to 10.9 and p value of less than .005. So the difference between pre laser mean IOP and post laser mean IOP at 1, 3 and 6 months was highly significant.

Pair T test was conducted to see the reduction in prelaser and post laser medication. Mean difference in prelaser medication was 2.307 with 95% confidence interval from 2.12 to 2.49. While 6 months post laser medication mean difference was 1.053 with 95% confidence interval ranging from 0.89 to 1.22. with p value less than 0.005 which was highly significant.

DISCUSSION

In the developing world treatment options for glaucoma are becoming more complicated as all treatment modalities and health care facilities are not available in all environments. In addition cost of medicines and hurdles in their distribution make medical treatment of glaucoma very difficult and sometimes impossible in most of the developing countries. Prostaglandin analogs are said to be the first line of treatment currently¹⁰. Topical B blockers, alpha adrenergic agonists and Carbonic anhydrase inhibitors may be used as additional therapies when required

but there may be a significant inter patient variability in their response^{11,12}.

ALT has been known to be an effective method for reduction of IOP in POAG patients. Use of this modality as an adjunctive to the medical treatment cannot be overlooked. ALT does not cure glaucoma but provides a long term reduction in IOP when used as an adjunctive treatment to medical treatment of glaucoma. In addition ALT cannot be relied upon as primary treatment option in patients who have poor compliance as there may be long periods of uncontrolled IOP. So ALT could be a better adjunctive treatment for glaucoma rather than primary treatment¹⁰.

We conducted this study to document the efficacy of this procedure as an adjunctive therapy to medical treatment in patients of POAG. We found in our study that there was a mean reduction of 9.18 mm Hg in post laser IOP as compared to base line and 6 month follow up period there was a significant reduction in number of topical medications. A randomized clinical trial known as Glaucoma Laser Trial GLT was carried out in America to assess safety and efficacy of LTP for controlling IOP in POAG patients. They reported a mean reduction of 9 mm Hg in IOP among the laser treated eyes as compared to 7 mm Hg reduction in IOP among those who were treated with medical treatment. The study also reported that ALT could be regarded as an equally effective therapy as medical treatment for POAG patients. Our study also reported similar reduction in IOP¹².

Shawartz and Coworkers also reported a drop of 9.7 mm Hg in mean IOP at 2 months follow-up, 7.3 mm Hg at 2 years and 4.9 mm Hg at 5 years follow up after Argon Laser Trabeculoplasty in cases of POAG¹³. Speath and Et al concluded in their study that LTP deferred the need of surgical treatment in about one third of the patients of POAG¹⁴.

Sharma and Gupta reported 76% success rate of ALT in POAG in their study.⁹ One of the local study by Mehar and et al reported 12.1 mmHg reduction in mean IOP at 6 months follow up in their case series of 35 eyes¹⁵.

Detry-Morel et al also reported a mean reduction of 4.9 mm Hg in IOP and significant reduction in number of drugs required at final visit along with minimal anterior chamber inflammation¹⁶. Grinich et al reported 7.8 mm Hg reduction in IOP at 3 years follow-up¹⁷. Achadi Et al reported 40.3% success rate of ALT at 5 years follow up¹⁸.

Agarwal and et al reported reduction of 7.2 mm Hg in mean IOP at 6 month follow up after LTP which is quite similar to 9.18 mm Hg post laser reduction of IOP in our study. Post Laser complications in their study like transient rise of IOP was found to be 51.3% patients, Iritis in 5% patients, formation of peripheral anterior synechia in 2.5% patients and rarely hyphaema¹⁹.

The frequency of complications was fewer in our study like mild iritis was seen in 7 (6.14%) patients, transient rise in IOP in 2 (1.75%) patients and no hyphaema. The reason for few complications could be that patients were kept on topical nonsteroidal anti-inflammatory drugs in addition to steroids and topical brimonidine.

In our study pre laser patients on 3 medications were 20 (18%), those on 2 medications were 49 (43%) and on one medication were 25 (22%). At 6 months follow up 4 (3.5%) patients were on 3 medications and 35 (31%) patients were on 2 medications and 38(33%) on one medication. This reduction in medications was statistically significant p value < 0.005. Drug free patients at 6 months follow up were 37 (33%) while 4 (3.7%) patients had to be supplemented with trabeculectomy due to uncontrolled IOP at 6 months follow up. In study by Agarwal 10.2% patients underwent trabeculectomy at 6 months follow up. Agarwal and et al reported 10% drug free patients, 15% on one medication and 20% on 2 medications at 5 year follow up. The differences from our study could be due to their prolonged follow up period¹⁹.

Adequate safety and efficacy profiles of laser trabeculectomy have been reported. Due to the reliable safety and efficacy of laser trabeculectomy this procedure can be used at any time during the treatment of POAG as primary or adjunctive therapy and also decreases the need of any medical treatment before going for any surgical intervention²⁰.

It can also be tried before cataract surgery of glaucoma patients to achieve a better management of IOP and to reduce the number of medications in patients who are on more than one drug. In addition it can be used in patients who are at risk of rise in IOP after receiving intravitreal injections²¹. Majority of the studies reported 25-30% post laser decrease in IOP²².

Another study reported that if LTP is used earlier in treatment of POAG the risk of adverse effect is diminished as the number of medications are decreased to reduce the IOP.²³ Stein Et al reported that

LTP is economical and cost effective as compared to medical treatment²⁴.

Limitation of our study is short term follow up period. Long term follow up is required to determine efficacy of ALT as an adjunctive therapy for prolonged control of IOP in POAG.

CONCLUSION

We concluded from our study that ALT is a safe and effective method to control IOP in POAG when used adjunct to medical therapy. It helps in decreasing the number of topical medications used for management of POAG and is thus cost effective.

Conflict of Interest: None.

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