

Experience with argon laser trabeculoplasty in Nigerians

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SUMMARY

Aim: To report the safety and efficacy of Argon Laser Trabeculoplasty (ALT) in reducing intraocular pressure (IOP).

Settings and Design: This was a retrospective study performed on 25 eyes of 25 patients.

Methods and Materials: Consecutive patients who met the inclusion criteria for ALT were recruited from the ophthalmic clinic of the University College Hospital Ibadan, Nigeria and followed up for a minimum period of six months. Two criteria were used to define successful response. Criterion 1 was defined as IOP reduction of 3mmHg or more without additional intervention while criterion 2 was IOP reduction of 20% or more from the pretreatment IOP

Statistical Analysis: Data was analyzed using SPSS version 16. Frequencies and means were generated to observe patterns of variable distribution among the patients. P value < 0.05 was considered significant.

Results: The mean pretreatment IOP was 19.9 ±3.1mmHg, (range of 16 to 26 mmHg). Mean post treatment IOP at 6 months was 14.9 ±2.2 mmHg, (range of 11 to 19 mmHg). Mean IOP reduction at one year was 4.6 mmHg, representing a 22.3% drop. There was a statistically significant greater IOP reduction in eyes (P<0.001) with higher pretreatment IOP. Based on criterion 1 and 2, 84.0% of the patients had successful outcome at six months while at one year, 76.9% were successful based on criterion one.

Conclusion: To the best of our knowledge, this is the first study to report the efficacy of ALT in Nigerians. ALT is safe and effective in reducing IOP in Nigerians.

Key messages: ALT is safe and effective in reducing intraocular pressure in this population of Nigerians

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Keywords: Argon laser trabeculoplasty, Nigerians, Primary open angle glaucoma, intraocular pressure, outcome

INTRODUCTION

Glaucoma is the leading cause of irreversible blindness worldwide^{1,2} and in Nigeria.³ It is estimated that about 11.1million people will be blind by 2020.⁴ According to the National Blindness Survey, glaucoma is responsible for 16.7% of blindness in Nigeria.³ The prevalence of glaucoma in West Africa and other ancestrally linked population ranges from 6.9-8.8%⁵⁻⁸ which is quite higher in comparison to Caucasians. Glaucoma in West Africa is often associated with a higher intraocular pressure, more rapidly progressive, and patients usually present late with up to 50% of cases already blind in one eye at presentation.⁵ The tremendous scarcity of resources for eye care in Nigeria and the high prevalence of the disease results in a high rate of preventable glaucoma related blindness.

Currently, lowering the intraocular pressure (IOP) is the only proven way to prevent development and progression of glaucoma.⁴ Glaucoma can either be treated medically, surgically or with the use of lasers. The cost of medical treatment is high and oftentimes unaffordable. This is further complicated with the problem of poor compliance and unavailability of these medications. The uptake of surgical procedures in management of glaucoma in Nigeria is discouraging. Studies in Nigeria suggest the uptake rate to be as low as 8-32% of patients.^{9,10}

Argon laser trabeculoplasty (ALT), was introduced by Wise and Witer in 1979 and it is a standard option in the clinical management of open-angle glaucoma (OAG).¹¹ The five-year success rate with ALT is reported to be 50%, with a decrease of 6% to 10% per year.¹² Selective laser trabeculoplasty was introduced as an alternative to

ALT by Latina and Park in 1989.^{13,14} In contrast to the ALT, SLT selectively targets the pigmented trabecular meshwork. Many studies have reported that both argon and selective trabeculoplasties are similar in terms of their ability to reduce intraocular pressure and their complication rates.¹⁵⁻¹⁷

Argon laser trabeculoplasty has been shown to reduce IOP in multiple clinical studies.¹⁸⁻²⁰ It is non-invasive unlike trabeculectomy, and it may also eliminate the issue of non-compliance to medications when used as initial treatment.^{18,21} This may be a useful alternative to medical and incisional surgical treatment of glaucoma²¹ especially in resource constrained regions of Sub-Saharan Africa. ALT has been shown to be effective when used as an adjunct to medical therapy in African-derived Caribbean individuals with glaucoma.²² To the best of our knowledge there has been no report on the efficacy and safety of argon laser trabeculoplasty in Nigerians. This study reports the one-year outcome of argon laser trabeculoplasty in Nigerians.

METHODS

This was a retrospective study performed on 25 eyes of 25 patients who were recruited consecutively from the ophthalmic clinic of the University College Hospital. Baseline characteristics such as age, sex, history of hypertension, diabetes, number of antiglaucoma medications, and baseline IOP were collected. The inclusion criteria for the procedure were patients with primary open angle glaucoma who had uncontrolled or suboptimal IOP control despite maximum tolerable medical therapy as evidenced by progressive visual field defects on automated standard Humphreys visual field test. Patients who had less than six months follow up, angle closure glaucoma or < 40 years of age were excluded from the study. All patients were on at least one anti-glaucoma medication prior to treatment. Ethical approval was obtained and the study complied with the declaration of Helsinki.

Argon laser trabeculoplasty was done as an adjunct to medical therapy in all patients. The primary outcome was the IOP lowering effect of ALT at a minimum follow up period of six months and the secondary outcome was the safety of the procedure. Twenty-three patients (92.0%) had a minimum follow up of one year. Two patients were lost to follow up.

Laser surgical procedure

All laser surgical procedures were performed by O.O. All patients were pretreated with one drop of gutt brimonidine 0.2% (alphagan). One hour after pretreatment with 0.2% brimonidine, a drop of topical anaesthetic agent (tetracaine) was applied to the eye to

be treated. With the use of a laser antireflective coated Goldmann two mirror lens (Ocular Instruments, Bellevue, WA, USA), 50 applications of 50 micrometer spot sized burns of 0.1s were delivered to the junction between the non pigmented and pigmented part of the trabecular meshwork. Only 180 degrees of the anterior chamber angle was treated at a sitting with approximately 25 burn applications delivered to each quadrant. Laser power was adjusted between 400 and 1,200mW to produce tiny champagne bubbles. Patients were thereafter placed on gutt diclofenac (Voltaren Ophtha) 6 hourly for one week.

Outcome

Patients were evaluated at one month, six months and one year. At each visit, anterior segment examination, visual acuity and IOP measurements were performed. Complications such as anterior segment inflammation, hyphema and post laser IOP spikes were recorded on the proforma. IOP was measured with the Goldmann applanation tonometer between 9.00am and 12 noon to minimize the effect of diurnal variations. The mean of 2 readings at the same sitting by a single examiner at each visit was recorded. Two criteria were used to define successful response to ALT based on an earlier study.¹⁶ Criterion 1 was defined as IOP reduction of 3mmHg or more without additional intervention (glaucoma surgery) while criterion 2 was defined as IOP reduction of 20% or more from the pretreatment IOP. Bivariate analysis was performed to determine the association between baseline factors and post laser IOP drop using a minimum IOP drop of 6mmHg. All statistical analysis was performed using SPSS software 18.0 (SPSS, Inc, Chicago, Illinois, USA). Statistical significance was set at $P < 0.05$.

RESULTS

A total of 25 eyes of 25 patients were treated during this period. There were 9 males (36.0%) and 16 females (64.0%). The mean age was 58.0 ± 7.3 years (range of 40.0-70.0 years). Twenty-three patients had a minimum follow up of one year (88.5%). Two patients were lost to follow up. All the patients were on medical therapy for glaucoma and all the patients had open angle glaucoma with Shaffers grade ≥ 3 on gonioscopy. Many of the patients 15 patients (60.0%) were on maximum tolerable medical therapy at least 3 different anti-glaucoma medications. The mean eye-drop use was 2.8 ± 0.9 . Table 1 shows the baseline characteristics.

Changes in intraocular pressure

The mean IOP at baseline (prior to treatment) was 19.9 ± 3.1 mmHg (range of 16.0-26.0mmHg). The mean IOP one month after ALT was 15.6 ± 3.2 mmHg while at 6 months the mean IOP was 14.9 ± 2.2 mmHg.

The mean IOP drop 6 months post treatment was 5.1±2.0mmHg which represented 25.2% drop.

Table 1 Baseline characteristics of patients who had Argon laser trabeculoplasty

Age (SD) (years)	58.0(7.1)
Sex:	
Male (%)	9(36.0)
Female (%)	16(64.0)
Diagnosis	
POAG (%)	25 (100.0)
Risk Factors	
Hypertension (%)	13 (52.0)
Diabetes (%)	3 (12.0)
Family History (%)	2 (8.0)
Number of glaucoma medications	
1	2 (8.0)
2	8 (32.0)
3	7 (28.0)
4	8 (32.0)

Table 2 compares the mean IOP pre-treatment with the mean IOP drop with time. In the short term however, (one month) the mean IOP drop was 5.2±3.4mmHg which represented 24.6% drop, while in the long term (one year) the mean drop was 4.6±2.7mmHg representing 22.3% drop. Figure 1 shows the IOP reductions after ALT at one month, six months and one year. Based on criterion 1 and 2, 84.0% of the patients had successful outcome at six months. At one year based on criterion one, 76.9% of the patients had successful outcome while 53.8% had successful outcome based on criterion two. Figure 2 shows the survival curve of the cohort of patients based on criterion one.

Table 2 Comparison of the mean pretreatment IOP with mean IOP drop based on time

	Mean +SD (mmHg)	P Value
Mean IOP Pre-treatment	19.9±3.1	
Mean IOP at one month	15.6±3.2	<0.01
Mean IOP at six months	14.9±2.2	<0.01
Mean IOP at one year	15.5±2.7	<0.01
Mean IOP Drop at one month	5.2±3.4	<0.01
Mean IOP Drop at six months	5.1±2.0	<0.01
Mean IOP Drop at one year	4.6±2.7	<0.01
Mean % IOP Drop at one month	24.6±17.2	<0.01
Mean % IOP Drop at six month	25.2±9.1	<0.01
Mean %IOP drop at one year	22.3±12.9	<0.01

Factors Affecting Intraocular Pressure Lowering

The level of IOP before ALT was a significant factor affecting the IOP reduction. Patients who had IOP greater than 20 mmHg before ALT had more IOP reduction (6-8mmHg) compared with patients who had less than 20mmHg (0-5mmHg). Patients with higher pressures had more pressure reduction than patients with lower pre-ALT IOP. (Table 3).

Other factors such as gender, family history, hypertension and diabetes did not influence IOP reduction. Table 3 shows the bi -variate analysis of different factors.

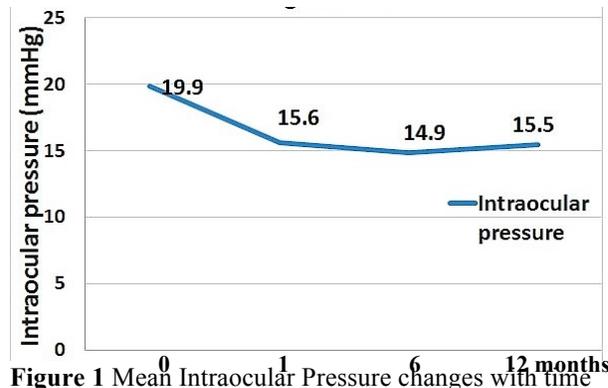


Figure 1 Mean Intraocular Pressure changes with time

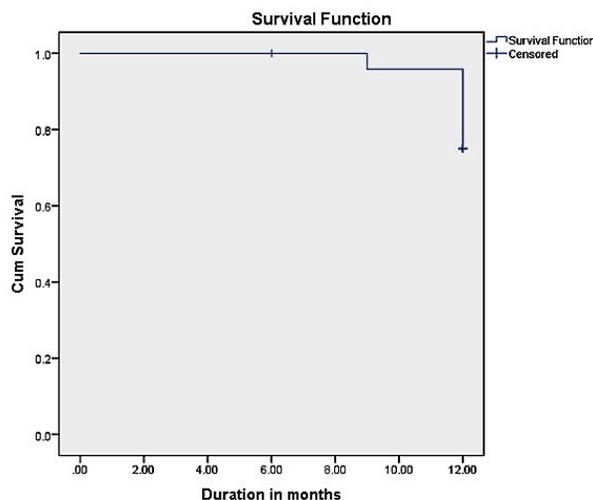


Figure 2 Shows the survival curve of the cohort of patients based on criterion one

In multivariate analysis, the only predictor of postoperative IOP was the IOP before ALT such that patients who presented with IOP of ≥21mmHg had an IOP reduction of >5mmHg from the baseline and this was statistically significant. (P<0.001, F=27.6)

Table 3 The bi variate analysis of the relationship between baseline factors and intraocular pressure drop post laser

Variable	Pearson Chi Square	P-Value
Gender	0.76	0.38
Family History	1.70	0.19
Hypertension	1.06	0.30
Diabetes	0.15	0.6
IOP before ALT	13.09	<0.001

There was no case of hyphema during and after the procedure, all patients had minimal inflammation in the early post-operative period which was managed with anti-inflammatory drops and only 2 patients (8.0%) had higher IOP than at baseline one hour after the procedure.

DISCUSSION

Several studies have documented the efficacy and acceptability of ALT in the management of patients with open angle glaucoma especially among Caucasians and Asians.^{18,20} To the best of our knowledge, this is the first study to document the efficacy of ALT in an indigenous Nigerian population. All the patients in our study had POAG and were all on anti-glaucoma medications before ALT procedure.

ALT is known to cause reduction of IOP by increasing aqueous outflow. One mechanism through which it does this is by mechanically tightening the trabecular meshwork lamellae thereby opening up the inter-trabecular spaces.^{23,24} Another mechanism is by cellular activation of the trabecular meshwork which leads to an increase in the number of cells involved in maintaining the trabecular meshwork flow.^{25,26}

We reported one-year success rate in 23 patients (92.0%) where success was defined as a $\geq 20\%$ drop in IOP from baseline. Success rates after ALT depends on the definition of success and the IOP control also varies with time.^{19,27,28} The mean IOP reduction in our study was low compared with other studies. The glaucoma laser treatment trial reported a mean IOP drop of 9 mmHg after primary ALT¹⁸ while the Moorfields primary treatment trial²⁹ reported an IOP reduction of 14mmHg after 6 months from a high pre-treatment IOP of 35mmHg. Others have reported values ranging from 5.9 to 12.1mmHg.^{21,30,31} Agarwal et al in India²⁰ performed ALT in 40 eyes of 21 patients. Compared to our study the pre-laser IOP was much higher (25.8mmHg) and this reduced to 17.8mmHg in 6 months suggesting an 8mmHg reduction. One explanation for this, is the relatively higher baseline intraocular pressures in all these studies compared with our study which had a lower baseline IOP.

Initial ALT treatment has been shown to be as efficacious as initial treatment with topical medications.¹⁹ ALT has been a standard therapeutic procedure in open angle glaucoma.²⁶ Some investigators reported that the 5-year success rate of ALT is 50% with a 6% to 10% decrease every year.^{32,33} Spaeth et al²⁸ however reported that ALT could control IOP for 5 years in about one third of cases.

This study demonstrated that ALT is effective in lowering IOP from baseline with minimal complications in Nigerians. This is similar to a study done by Damji et al¹⁵ who reported less anterior chamber patients who had ALT compared with SLT. Another study³⁴ however reported a higher frequency of anterior chamber inflammation in patients who had ALT compared with SLT. Both studies however reported a very low rate of complications which is similar to our study. Our results showed that a higher baseline IOP was associated with more IOP reduction and this was statistically significant. In a study on the effect of ALT in the Early Manifest Glaucoma Trial,³⁵ the authors reported that the pre-treatment IOP was the most important factor influencing the effect of treatment. They found that for every 1 mmHg higher IOP there was a 2-3mmHg greater pressure reduction. This finding has also been reported in other studies.^{15,16} All other variables such as gender, family history, hypertension and diabetes did not influence the level of IOP reduction. This may suggest that these baseline factors do not influence trabecular meshwork response to laser treatment.

Although studies have shown that ALT and SLT have similar outcomes in terms of IOP reduction potential, biological effects and complication rates,^{16,36,37} SLT still has the advantage of repeatability. ALT is known to cause coagulation damage and scarring of the trabecular meshwork.¹⁵ Repeat treatment may therefore lead to scarring and excess damage which can lead to increased IOP and subsequent inefficacy in repeat trabeculoplasties.¹⁵

Majority of studies on the efficacy of ALT have been reported in Caucasians.^{15,18,19,27} Although there are other modalities of managing glaucoma such as medical and filtering surgeries, they are associated with some challenges that make laser management especially desirable in many parts of sub-Saharan Africa. The issues of drug compliance, availability and affordability of antiglaucoma drugs make medical management less desirable in this part of the world. Filtering surgery has been advocated in this population,³⁸ however, it has some disadvantages which include scarring of the bleb with time, faster progression of cataracts, and the life-long risk of endophthalmitis.²¹ There are some limitations to this study. This includes the small sample size and the short follow up period of the patients.

All the patients in this study were on medical management for their glaucoma hence ALT was used as an adjunct. It will be interesting to perform another study in indigenous Nigerian population using ALT as primary treatment of glaucoma and following up the patients for a longer period.

CONCLUSIONS AND RECOMMENDATION

This study adds to the body of knowledge and demonstrates that ALT is effective in this population of Nigerians with minimal complications. The procedure may also be used to defer the need for filtration surgery in this population. We recommend it as an alternative treatment option in patients with suboptimal IOP control. More studies are needed to report the long-term efficacy of ALT in Nigerians.

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