Original Article

Efficacy and Complications of Modified Laser Iridotomy in Primary Angle Closure Glaucoma

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Purpose: To evaluate the efficacy and immediate complications of modified laser iridotomy in primary angle-closure glaucoma.

Study Design: Case series.

Place & Duration of Study: Department of Ophthalmology, Liaquat University of Medical & Health Sciences, Hyderabad, Pakistan from November 2011 to May 2012.

Material and Methods: In this study 115 Patients of 41 to 60 years, with diagnosis of primary angle closure glaucoma were included, while patients with secondary angle closure glaucoma and all those patients in whom angle was not visible due to corneal opacity or haze were excluded from the study. Prior to laser therapy all patients were explained about the procedure and a written consent was obtained. A combination of Argon and YAG for laser iridotomy (modified laser iridotomy) was used in all the patients. The patients were followed-up at 1st day, 1st week, and 4 weeks after treatment with slit lamp examination and intraocular pressure measurement. The data was entered and analyzed using SPSS version 16.0.

Results: 88 patients (76.5%) had intraocular pressure reduction of more than 8 mm Hg and14 (12.17) patients had reduction in IOP 5 to 8 mm Hg, while only 13 (11.3%) patients had reduction of less than 5 mm Hg after 4 weeks. Among the complications, iritis was the most frequent complication noted, 95 (82.6%) patients had iritis on day one, which reduced to 03 (2.61%) patients after 4 weeks.

Conclusion: Modified laser iridotomy (Argon followed by Nd: YAG Laser) is an effective treatment option for Primary Angle Closure Glaucoma, with few reversible side effects.

Key words: Angle Closure, Glaucoma, Laser Procedures, iridotomy

Glaucoma is one of the leading causes of severe visual impairment and blindness worldwide[1]. Primary angle-closure glaucoma (PACG) is a major cause of irreversible blindness globally particularly in Asia where it represents the major form of glaucoma[2]. An estimate shows that 55.3 million people worldwide will be blind owing to PACG by 2020[3].

PACG needs an urgent management to lower the intraocular pressure (IOP) and minimize the risk of vision loss[4]. The last decade has seen a paradigm shift in the treatment of angle-closure glaucoma from incisional surgery to laser surgery as the preferred method for creating an opening in the irides[5]. This is because of no need of using retrobulbar anesthesia, anterior chamber maintainer, absence of the risk of infective endophthalmitis and it can be applied as an outpatient procedure[6].

Neodymium-Yttrium-Aluminum-Garnet (Nd: YAG) laser iridotomy is effective in reducing IOP in people with PACG[7]. Nd:YAG is a better option than Argon because of easy iris penetration and a lower incidence of iridotomy closure[8]. Its efficacy is greater in light colored irides, but in dark irides alone it is associated with high risk of failure and complications, like iris hemorrhage occurring in about 40%, which is severe enough to postpone the procedure[9,10]. Argon laser pre-treatment significantly reduces iris haemorrhage[11]. The modified laser iridotomy (MLI) is an advanced technique to treat the PACG and it uses the benefits of both lasers and avoids their disadvantages and complications[12]. Therefore in dark Asian irides, it is probably the best technique to be used[12].

A study from Pakistan on the efficacy of Argon followed by Nd:YAG laser reported that this technique was useful in controlling IOP in 75% cases after 6 months of follow-up. They reported postoperative complications like iritis in 80% cases followed by raised IOP in 45% cases, hyphema in 35% and corneal damage in 5% cases[6]. The rationale of this study is to find out if Nd:YAG laser combined with Argon laser significantly reduces iris hemorrhage and achieves higher rate of single treatment success in PACG[5,12]. This would greatly benefit the patients and also result in less post-operative visit so reducing overall burden of patients in the outpatient department.

MATERIAL AND METHODS

This study was carried out at Department of Ophthalmology, Liaquat University of Medical and Health Sciences, Hyderabad, from November 2011 to May 2012. Patients of 40 to 60 years age, with diagnosis of PACG were included in the study. All those patients in whom angle was not visible due to corneal opacity or haze, secondary angle closure glaucoma, severe progressive type of glaucoma in which angle was not visible were excluded from the study.

After taking history regarding previous attack, treatment and surgery of glaucoma Snellen visual acuity was measured in all subjects prior to doing fundoscopy. A slit lamp examination was carried out, looking for ischemic sequelae of angle closure and signs of secondary glaucoma. Intraocular pressure (IOP) was measured with a tonometer (Goldmann model, Haag-Streit, Bern, Switzerland). The median of three tonometer readings were recorded as a base line IOP for each eye. Gonioscopy was performed with a three mirror Goldmann gonioscopy lens to record the width of the irido-trabecular recess in the four quadrants. The angle was graded as occludable or open. An occludable angle was defined as one in which three quarters of the posterior pigmented trabecular meshwork was not visible in the primary position of gaze without indentation. Primary angle closer glaucoma was diagnosed in eyes with an occludable angle and glaucomatous optic neuropathy. Evidence of glaucomatous optic neuropathy was defined as a cup: disc ratio (CDR) of > 0.7 or > 0.2 CDR asymmetry. Dynamic (indentation) gonioscopy using three mirrors Goldmann lens was performed to assess the presence or absence of peripheral anterior synechiaes (PAS) in each quadrant.

Prior to laser therapy all patients were explained about the procedure and a written consent was obtained. A combination of Argon and Nd: YAG for laser iridotomy was used in all the patients. Nd: YAG laser Abraham iridotomy lens was used with methylcellulose as a coupling solution. The laser settings were, a power of 1000mw of Argon laser with a spot size of 50 microns requiring 50-80 numbers of shots. The laser settings for Nd: YAG laser were a power of 4 – 6 mJ requiring 3 – 5 shots. The iris tissue was thinned to 20% thickness with argon laser. After this the 2 – 3 shots of Nd: YAG laser was applied into the depth of the crater to complete the iridotomy, so that the anterior lens capsule was visible through the opening made by the iridotomy.

One hour after the laser IOP was checked and all the patients were discharged on topical steroid (prednisolone acetate) eye drops four times a day and a topical beta blocker eye drops twice a day for five days. The patients were followed up at 1st day, 1st week, and 4 weeks after the treatment. At each visit the patients were examined for visual acuity, IOP measurement using applanation tonometry, anterior chamber reaction was noted, patency of iridotomy and gonioscopy was performed to confirm the extent of peripheral anterior synechiae.

The data was entered and analyzed using SPSS version 16.0. Frequencies and percentages were calculated for categorical variables like gender, raised IOP, iritis, hyphema and corneal damage. Mean and standard deviation (SD) were computed for quantitative variable like age. Data was stratified based on age and gender to see the effect of modified laser iridotomy. After laser treatment if the IOP

decreased greater than 8 mm Hg from the baseline IOP the procedure was labeled as efficacious, good if 5 – 8 mm Hg decrease and poor if less than 5 mm Hg decrease.

RESULTS

There were 115 patients with PACG, 51 (44.3%) were males while 64 (55.7%) were females. Average age of the patients included in the study was 52.95 (± 4.52) years, with range of 41 – 60 years. The age, gender, laterality and age distribution among genders is shown in Table 1. Stratification based on age, gender and side of eye to see the effect modifier is shown in Table 2, Table 3 and Table 4. One day after laser 35.7% eyes, while four weeks later 76.5% eyes had IOP reduction of more than 8 mm Hg (Figure 1). One day and one week after laser, iritis (82.6% and 10.43%) was the most frequent complication noted (Figure 2). After four weeks of treatment none of the patients had hyphema, while rise in IOP was noted only in 1 (0.87%) patient.

Table 1: Patient Characteristics N = 115

Characteristics	N (%)
Gender M:F = 1: 1.2	
Male	51 (44.3)
Female	64 (56.7)
Laterality	
Right	67 (58.3)
Left	48 (41.7)
Age at presentation (years)	
Mean ± SD	52.95 ± 4.5
Min – Max	41 – 60
Males	
Mean ± SD	53.25 ± 4.1
Min – Max	42 – 59
Females	
Mean ±SD	53.17 ± 4.8
Min – Max	41 – 60
Age Groups	
41-50 Years	
Males	09
Females	12
50-60 Years	
Males	42
Females	52

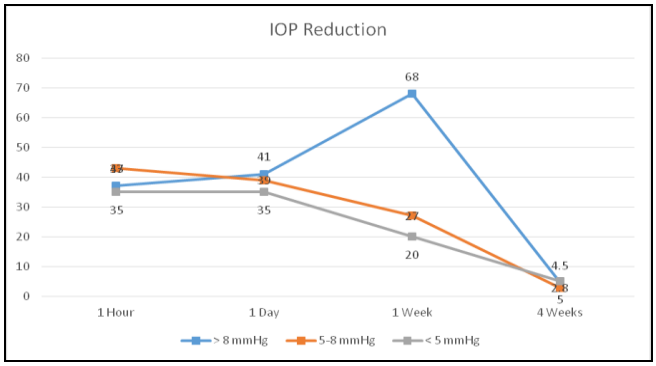

Fig. 1: Intraocular Pressure Reduction after Laser N = 115.

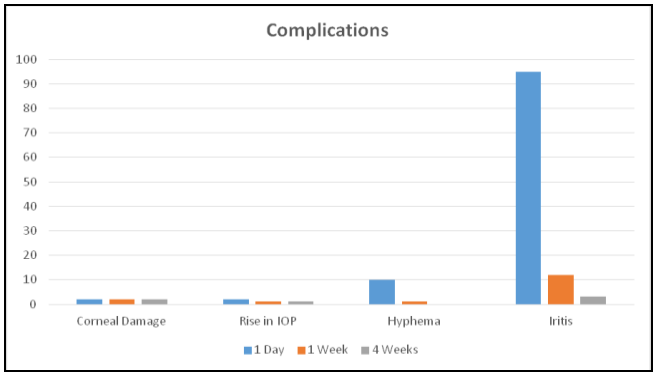

Fig. 2: Complications after Laser iridotomy N = 115.

DISCUSSION

Glaucoma is a silent thief of vision which affects scores of people worldwide. PACG is the most dangerous type with profound irreversible loss of vision. In Asians PACG is the more prevalent form of glaucoma[1]. In Mongolia the prevalence of PACG is 1.4%[13], with more than 6.55% of population having occludable angle.

There are a number of treatment options available for PACG, like anti-glaucoma medicines, laser modalities and surgical options. Anti-glaucoma medicines are expensive and require regular follow up and good compliance, while surgical options are

Table 2: Stratification based on age to see the effect modifier N= 115

		IOP reduction of > 8 mm Hg	IOP reduction of 5-8 mm Hg	IOP reduction of <5 mm Hg	P value
Day 1	Age group 40 – 50	8	12	1	0.008
	Age group 50 – 60	33	27	34	
Week 1	Age group 40 – 50	15	6	0	0.011
	Age group 50 – 60	53	21	20	
Week 4	Age group 40 – 50	19	2	0	0.049
	Age group 50 – 60	69	12	13	

Table 3: Stratification based on gender to see the effect modifier N= 115

		IOP Reduction of > 8 mm Hg	IOP Reduction of 5-8 mm Hg	IOP Reduction of < 5 mm Hg	P value
Day 1	Males	22	11	18	0.044
	Females	19	28	17	
Week 1	Males	27	14	10	0.480
	Females	41	13	10	
Week 4	Males	41	6	4	0.550
	Females	47	8	9	

Table 4: Stratification based on laterality to see the effect modifier

		IOP Reduction of > 8 mm Hg	IOP Reduction of 5 – 8 mm Hg	IOP Reduction of < 5 mm Hg	P value
Day 1	Right Eye	20	10	20	0.044
	Left Eye	21	29	15	
Week 1	Right Eye	32	16	11	0.480
	Left Eye	36	11	09	
Week 4	Right Eye	40	05	05	0.550
	Left Eye	48	09	08	

reserved for advanced glaucoma and have a high rate of failure especially in case of PACG. In developing countries like Pakistan, glaucoma has a high burden on both patients and economy due to which most patients are not compliant and lost in follow up. Here comes the significance of looking for treatment options in which patients do not need to be followed frequently and also patients do not require expensive anti glaucoma medications. In cases of PACG, such treatment option with one time treatment, no frequent follow ups and no need of expensive anti-glaucoma medication required would be in the form of laser peripheral iridotomy (LPI)[14]. LPI works by relieving the relative pupillary block and thus relieving PACG. But LPI may not work in non-pupillary block PACG.

LPI can be done by Argon laser which causes photocoagulation of the iris tissue resulting in shrinkage and charring of iris. But the LPI done by Argon laser alone showed higher failure rate particularly in dark irides[14]. It also resulted in many complications including corneal endothelial burns, endothelial cell loss and retinal burns. Around 10% of the patients developed endothelial cell loss[15].

After these failure results and complications were observed, Argon laser was replaced with YAG laser LPI, which works by photodisruption[16]. Light pigmented irides showed much better results with YAG LPI as compared to the darkly pigmented irides because they required less energy[22]. YAG had less closure rate than Argon LPI but like any other procedure it had some problems like the use of higher energy levels in dark irides, iritis, corneal burns, reduction in endothelial cell count, diplopia and hemorrhage[16-18]. If LPI is performed with lower energy and peripherally it can prevent endothelial cell loss, diplopia and hemorrhage.

Considering the pros and cons of individual use of Argon and YAG laser, a modified Argon YAG laser iridotomy (MLI) was tried. This method was especially useful in dark irides which otherwise require high energy levels with individual lasers[19,20]. With MLI almost half energy was needed which resulted in less complications and the iridotomy was large and round in contrast with slit opening of YAG LPI.

In our study, initially after 1 day iridotomy was effective in lowering IOP more than 8 mm Hg from baseline IOP in 35.7% of patients which improved to 59.1% after 1 week and finally to 76.5%. Similarly over 30% of patients had reduction in IOP of <5 mmHg on day 1, which reduced to 17% on week 1 and finally to 11% after 4 weeks. This shows that IOP lowering effect of MLI may take 1 month to be fully effective. As far as complications are concerned, we observed four different complications including iritis, hyphema, corneal burns and rise in IOP. We observed that only 1.74 % of patients had IOP rise after one day of MLI which reduced to 0.87% after one week. As stated in a study by Harada, iris hemorrhages was observed in 17 % of patients when YAG laser was used, but in our study only 10.43 % of patients had hyphema (on day 1) [21].

In one recent study, they compared iridotomy outcomes in dark irides by using 1064 nm pulsed Nd: YAG either with pretreatment of Double frequency YAG laser (just like Argon laser). They observed that when single frequency YAG was performed alone it resulted in 43% iris hemorrhages, but when it was pretreated with double frequency YAG this complication was reduced to 13% only (p=0.0126). Around 2 out of 30 of patients in the standard treatment group (only single frequency YAG was used for LPI) were abandoned due to significant hemorrhage[22]. This is a high frequency of complications as compared to what we have reported in our study. This shows that sequential argon laser before YAG LPI is not only equally beneficial but results in much lower complications rate as compared to isolated YAG LPI. Iritis has been a well reported complication of both YAG and Argon LPI but only 3 patients in our study who underwent MLI had iritis after 4 weeks[23]. Schwartz reported a 75% success rate following MLI which is comparable to our study (76.5%). Other studies have showed variable frequencies of successful iridotomies in terms of lowering IOP[24].

CONCLUSION

Modified laser iridotomy (Argon followed by Nd: YAG Laser) technique is excellent for PACG, permitting effective IOP reduction in most of the patients. Although iritis was a frequently observed complication on day one after laser but with topical steroids it resolved in almost all the patients by week four. Thus, it is an effective treatment option for PACG, with few reversible side effects.

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Dr. Azfar Ahmed Mirza
Study Design, collected data, did critical appraisal of findings.

Dr. Noor Bakht Nizamani
Drafted the manuscript, statistically analyzed data and reviewed literature.

Dr. Mahtab Alam Khanzada
Data Analysis and interpretation, critically reviewed the manuscript.

Dr. Khalid Iqbal Talpur
Conceptualized the study and approved the final version

REFERENCES

1. **Quigley HA. Broman AT.** The number of the people with glaucoma worldwide in 2010 and 2020. Br J Ophthalmol. 2006; 90: 262-7.
2. **Foster PJ, Oen FT, Machin DS, Ng TP, Devereux JG, Johnson GJI.** The prevalence of glaucoma in Chinese resident of Singapore: a crosssectional population survey Tanjong Pagardistrict. ArchOphthalmol. 2000; 118: 1105-11.
3. **He M, Foster PJ, Johnson GJI.** Angle-closure glaucoma in East Asian and European people. Different diseases? Eye. 2006; 20: 3-12.
4. **Casson RJ, Newland HS, Muccke J, MeGovern S, Abraham LM, Shein WI.** Gonioscopic findings and prevalence of occludable angles in a Burnese population: the Meiktila eye study. Br J Ophthalmol. 2007; 91: 856-9.
5. **Baig R, Khan A.** Clinical outcome of iridotomy with Argon-YAG laser at a tertiary care center in Karachi, Pakistan JPMA. 2010; 60: 220-3.
6. **Gray RH, Naime JH, Ayliffe WH.** Efficiency of Nd-YAG laser iridotomies in acute angle closure glaucoma. Br J Ophthalmol. 1989; 73: 182-5.
7. **AmmarM, Rahman H, Butt IA, Ghani N.** Role of YAG laser Iridotomy as Initial Treatment of Primary angle closure. Rawal Med J. 2005; 30: 300-7.
8. **Quigley HA.** Long-term follow-up of laser iridotomy. Ophthalmology.1981; 88: 218-24.
9. **Moster ME, Schwartz LW, Spacth GI, Wilson RP, McAllister JA, PoryzeesEM.** Laser iridotomy, a controlled study comparing argon and Nd: YAG. Ophthalmol. 1986; 93: 20-4.
10. **Robin AL, Pollack IP.** A comparison of Nd: YAG and argon laser iridotomies. Ophthalmol. 1984; 91: 1011-6.
11. **Goins K, Schmeisser E, Smith T.** Argon laser pretreatment in Nd: YAG iridotomy. Ophthalmic Surg. 1990; 21: 497-500.
12. **De Silva DJ, Gazzard G, Foster PJ.** Laser iridotomy in dark irides. Br J Ophthalmol 2007; 91: 222-5.
13. **Foster PJ, Baasanhu J, Alsbirk PH.** Glaucoma in Mongolia-a population-based survey in Hövsgöl Province, northern Mongolia. Arch Ophthalmol. 1996; 114: 1235-41.
14. **Schwartz LW**, Rodrigues MM, Spaeth GL, et al. Argon laser iridotomy in the treatment of patients with primary angle-closure or pupillary block glaucoma: a clinicopathologic study. Ophthalmology. 1978; 85: 294-309.
15. **Berger BB**. Foveal photocoagulation from laser iridotomy. Ophthalmology. 1984; 91: 1029-33.
16. **Kielkopf JF**. Laser-produced plasma bubble. Phys Rev E Stat Nonlin Soft Matter Phys. 2001; 63 (Pt 2) :016411 [Medline]
17. **Kumar RS**, Baskaran M, Friedman DS, et al. Effect of Prophylactic Laser Iridotomy on corneal endothelial cell density over 3 years in primary angle closure suspects. Br J Ophthalmol. 2013; 97: 258-61.
18. **Ho T**, Fan R. Sequential argon-YAG laser iridotomies in dark irides. Br J Ophthalmol. 1992; 76: 329–31.
19. **Wu SC, Jeng S, Huang SC, Lin SM.** Corneal endothelial damage after neodymium: YAG laser iridotomy. OphthalSurg Lasers. 2000; 31: 411-6.
20. **Harada T, Mizuno K, Awaya S.** Contribution of the argon laser in iridotomy using the YAG laser. J FrOphtalmol. 1989; 12: 545-8.
21. **De Silva DJ, Day AC, Bunce C, Gazzard G, Foster PJ.** Randomised trial of sequential pretreatment for Nd:YAG laser iridotomy in dark irides. Br J Ophthalmol. 2012; 96: 263-6.
22. **Schwartz LW, Moster MR, Speath GL, Wilson RP, Poryzees E.** Neodymium-YAG laser iridectomies in glaucoma associated with closed or occludable angles. Am J Ophthalmol. 1986; 15; 102: 41-4.
23. **Agulto MB, BacsalKME, Lat-Luna MML.** A Prospective, randomized comparison of Nd:YAG and sequential argon-YAG laser iridotomy in Filpinoeyes.Philipp J Ophthalmol. 2004; 29: 131-5.
24. **Hsiao CH, Hsu CT, Shen SC, Chen HS.** Mid-term follow-up of Nd:YAG laser iridotomy in Asian eyes. Ophthalmic Surg Lasers Imaging. 2003; 34: 291-8