



STUDY OF ND:YAG LASER POSTERIOR CAPSULOTOMY AND ITS EFFECT ON INTRA OCULAR PRESSURE

Ophthalmology

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ABSTRACT

BACKGROUND: Despite much advancement in cataract surgery, Posterior capsular opacification (PCO) is a commonly encountered complication. These cases of PCO are amenable to Nd: YAG laser capsulotomy. However, IOP elevation is frequently observed in these cases.

AIM: To assess the pattern of IOP elevation following Nd: YAG laser posterior capsulotomy in pseudophakes in treatment and in non-treatment groups. **DESIGN:** Prospective interventional comparative study. **MATERIALS AND METHODS:** All the subjects were divided into two groups; 25 cases in group A received prophylactic treatment for IOP reduction whereas 25 cases in group B received no prophylactic treatment.

RESULT : In group A, at the end of one hour, three hours and 24 hours, the average IOP elevation was found to be 1.12 , 1.28 and 0.56 mm of Hg respectively. Likewise, in group B, at the end of one hour, three hours and 24 hours, the average IOP elevation was found to be 3.04, 3.28 and 1.76 mm of Hg respectively. In group B, the rise of IOP was significant ($p < 0.05$) at the end of 1 hour, 3 hours and 24 hours. **CONCLUSION:** It is concluded that prophylactic treatment helps in blunting off the IOP spikes following YAG laser capsulotomy.

KEYWORDS

PCO, Nd:YAG laser, IOP, Timolol

INTRODUCTION:

Despite much advancement in cataract surgery, Posterior capsular opacification (PCO) is a commonly encountered complication. This PCO causes either partial or complete obstruction of the visual axis, causing the problems of diminution of vision, increased glare which interfere with the day to day activities of the patient. So, in order to restore back vision lost due to PCO we need to remove PCO. These cases of PCO are amenable to Nd: YAG laser capsulotomy. However, IOP elevation is frequently observed in these cases. Various procedures are there for treatment of PCO, out of which Nd:YAG laser posterior capsulotomy proves to be an established, non invasive and safe procedure. This utilizes photodisruption property which is largely a mechanical effect of Nd:YAG laser at 1064 nm wavelength (infrared) using Q switched mode.

It is focused to a very small point producing an extremely high power density that literally rips electrons away from their nuclei creating plasma, this is known as optical breakdown. Powerful electromagnetic energy are required for optical breakdown produced by concentrating laser energy into very brief periods, thus, giving each pulse an extremely high power level. There are two ways to pulse an Nd:YAG laser either by Q switching and mode locking. Out of these two, Q switching is less expensive and reliable however, it cannot produce pulses as short or powerful as in mode locking. On recombination of these electrons, there is creation of acoustic vibration which creates the capsulotomy as the chemical nature of the material is destroyed. (1)

Nd:YAG laser clears the visual axis by creating a central opening in the opacified posterior capsule but it comes with certain inherent complications such as corneal haze, hyphaema, lens pitting, transient rise in IOP (2) uveitis, retinal detachment etcetera.

Following laser capsulotomy, transient rise of intraocular pressure usually peaks in the first 3 hours of doing laser (3) . It occurs probably due to clogging of the trabeculum with debris. This shoot up of IOP can range from 1- 10 mm of Hg or more and if on higher side, may lead to

serious ocular damage especially in glaucoma patients as is rooted by Advanced glaucoma intervention study – 7 (AGIS-7) (4) also in suspects and those vulnerable to ocular damage. For preventing this transient intraocular pressure rise there are varied opinions regarding use of ocular hypotensive drugs. So, due to lack of consensus about the efficacy and need of prophylactic treatment in Nd:YAG laser capsulotomy, this study was undertaken with the aim to evaluate pattern of intraocular pressure rise with or without prophylactic treatment with eye drop timolol maleate 0.5 %.

Timolol maleate - it is a beta blocker drug usually used in the treatment of glaucoma. It lowers the IOP along with reduction in risk of diminution and loss of vision. Timolol acts by reducing the formation of aqueous humor in the ciliary body.

OBJECTIVE: To assess the pattern of IOP elevation following Nd: YAG laser posterior capsulotomy in pseudophakes in treatment and in non-treatment groups.

MATERIALS AND METHODS

This is a prospective interventional comparative study conducted over a period of 20 months, from January 2016 till august 2017 at department of ophthalmology, JA hospital. This study was conducted in 50 eyes which were divided into two groups with 25 patients in each group after randomization. Inclusion of patients being done on the basis of - VA $< 6/12$ on Snellen's chart, IOP between 10 and 20 mm of Hg, patients giving full informed consent and willing to participate in this study and have completed at least three months after cataract surgery.

Group A included patients to whom prophylactic treatment was given before laser capsulotomy. Whereas, group B included eyes in which no such pre-treatment was done. Exclusion of patients was done on the basis of – patients using anti- glaucoma medication, corneal organic diseases, vitreous opacities, anterior uveitis, retinal detachment, advanced diabetic eye disease, high myopia, maculopathies, aphakic patients and in those in which use of drug was contraindicated (cardiac

and asthmatic patients). Prelaser assessment of patients was done for vision, baseline IOP, slit lamp examination to assess for any contraindication as well as to grade the PCO using Madurai PCO grading scale. 25 patients in group A were given prophylactic treatment 1 hour before laser (timolol maleate 0.5 %) following which mydriatic drops were instilled and in group B patients no pre laser treatment was given, only mydriatic drops were instilled. For the procedure, the patient was seated on slit lamp, topical anaesthetic 4 % proparacaine was instilled and abraham's contact lens was placed over the cornea with viscoelastic substance as coupling agent. Laser shots with low energy were given initially and gradually increased as per requirement. With minimum number of laser shots, a 2-3 mm diameter opening in the centre of the opacified capsule was made. Post capsulotomy, patients were assessed for IOP by Goldmann applanation tonometry immediately, after 1hr, after 3 hrs, after 24 hrs, at one week and at 6 weeks.

Statistical Analysis: This was done using unpaired 'T' test and analysis of variance to compare the data. The confidence interval of the study being kept at 95%, thus 'P' value less than 0.05 is indicated as statistically significant.

OBSERVATIONS:

Table 1
AGE DISTRIBUTION

S. No.	Age group (in years)	No. of Patients	Percentage
1.	0-20	0	0
2.	21-40	3	6
3.	41-60	15	30
4.	61-80	31	62
5.	81 and above	1	2
Total	50	100	

As shown in the table above age of the patients ranged from 22 years to 85 years with a mean age 60.88 +/- 13.74 years in group A and 61.32 +/- 12.88 years in group B. male to female ratio was almost equal with random distribution among groups A and B.

Table 2
SEX DISTRIBUTION

S. No.	Age group	Males		Females	
		No. of cases	%	No. of cases	%
1.	21-40	3	6	0	0
2.	41-60	7	14	8	16
3.	61-80	13	26	18	36
4.	Above 80	1	2	0	0
Total	24	48	26	52	

In this table out of 50 patients 24 (48 %) were males and 26 (52%) were females. Male: Female = 0.9:1. No sex predilection is seen. Maximum no. of patients belonged to 61-70 years of age group in both male and female patients – 10 (20%) and 16 (32%) respectively.

GRAPH 1
AGE AND SEX DISTRIBUTION

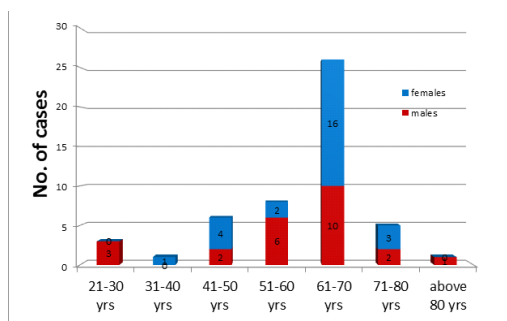


Table 3
TYPES AND GRADES OF PCO

Type of after cataract	Elschnig's pearls	%	fibrous	%	mixed	%	Total no. of cases	%
Grade I	14	28	6	12	0	0	20	40
Grade II	12	24	6	12	4	8	22	44
Grade III	1	2	4	8	3	6	8	16
Total	27	54	16	32	7	14	50	100

According to this table, out of 50 cases, 27 (54 %) were having elschnig's pearls and 16 (32 %) were fibrous type of PCO, also in 7 (14 %) cases it was mixed. Out of 50 patients, 20 (40 %) cases had grade I PCO, 22 (44 %) were grade II and 8 (16 %) cases had grade III type of PCO. This table also shows distribution of type of cataract according to grade of PCO.

GRAPH 2
Relationship between types and grades of PCO

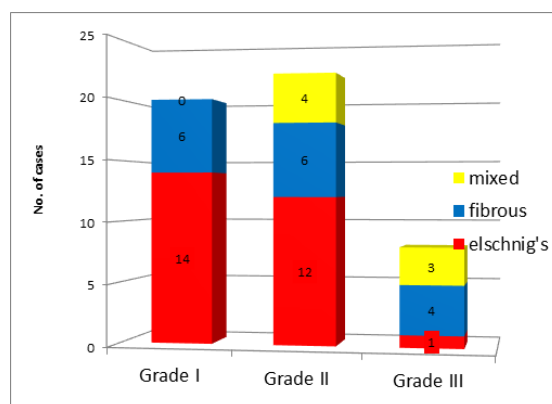


Table 4
DURATION BETWEEN CATARACT SURGERY AND LASER CAPSULOTOMY

S.No.	Interval between cataract Sx and YPC	No. of Patients	Percentage
1	3 months – 6 months	24	48
2	6 months – 1 year	7	14
3	1-2 years	11	22
4	2-3 years	7	14
5	>3 yrs	1	2
Total	50	100	

This table shows that the interval between cataract surgery and laser capsulotomy ranged from 3 months to > 3 years. Most of them 24 (48 %) cases had a history of cataract surgery 3 months- 6 months before YAG capsulotomy. In 1 year duration, cases having PCO was 31 (62 %). The number of cases also peaked during 1-2 years after cataract surgery.

Maximum interval from cataract surgery to capsulotomy was 5 years in a 60 year old male. This table also shows distribution of cases in treatment and non treatment groups.

GRAPH 3
DISTRIBUTION OF CASES DEPENDING UPON DURATION OF PCO FORMATION AND CATARACT SURGERY

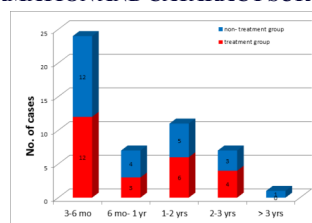


TABLE 5 RELATIONSHIP BETWEEN TYPE AND GRADE OF PCO AND ENERGY USED

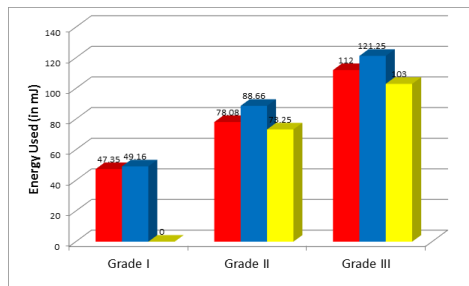
S no.	Type of PCO	Grade of PCO	No. of cases	Mean Energy used (mJ)
1.	Elschnig's pearls	Grade I	14	47.35
		Grade II	12	78.08
		Grade III	1	112
		subtotal	27	63.40
2.	Fibrous type	Grade I	6	49.16
		Grade II	6	88.66
		Grade III	4	121.25
		subtotal	16	81.995
3.	Mixed type	Grade I	0	0
		Grade II	4	73.25
		Grade III	3	103
		subtotal	7	86
TOTAL	50			

As in this table, in this series, the average energy used for laser capsulotomy for different types and grades is depicted. It was 47.35 mJ, 49.16 mJ for grade I PCO of types- elschnig's pearls and fibrous type.

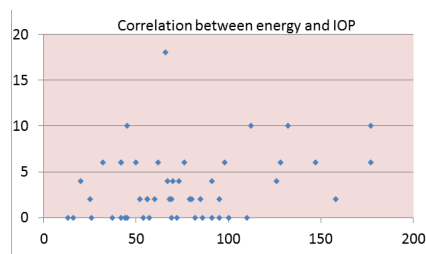
For grade II PCO average energy was 78.08 mJ, 88.66 mJ and 73.25 mJ respectively for elschnig's pearls, fibrous and mixed type of PCO.

For grade III, mean energy was 112 mJ, 121.25 mJ, 103 mJ respectively for elschnig's pearls, fibrous and mixed type.

Also, energy average energy required for grade I, grade II and grade III is 47.893 mJ, 80.08 mJ and 113.25 mJ.

GRAPH 4 RELATIONSHIP BETWEEN TYPE AND GRADE OF PCO AND ENERGY USED

Energy used and IOP rise

GRAPH 5 ENERGY USED AND IOP RISE

Correlation coefficient is 0.28 which shows very little (insignificant) correlation.

TABLE 6 IOP PATTERN AFTER YAG LASER CAPSULOTOMY WITH AND WITHOUT TREATMENT

S.N o.	IOP at various time interval	Group A (with treatment Timolol 0.5%) mm of Hg	Group B (without treatment) mm of Hg				
		Mean	S.D.	S.E.M	Mean	S.D.	S.E.M
1	Baseline	14.72	3.40	0.68	14.16	3.15	0.63
2	immediately	14.72	3.10	0.62	15.2	3.10	0.62

3	After 1 hr	15.84	3.15	0.63	17.2	4.43	0.88
4	After 3 hrs	16	3.31	0.66	17.6	3.74	0.74
5	After 1 day	15.28	3.45	0.69	15.52	3.01	0.60
6	After 1 week	13.6	2.95	0.58	13.76	2.60	0.52
7	After 6 weeks	13.68	2.80	0.56	14	2.44	0.48

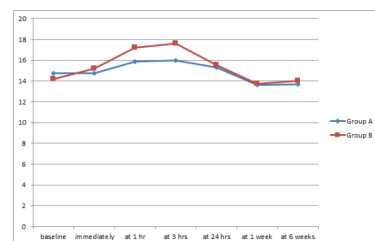
In the above table baseline IOP mean before the procedure was 14.72 +/- 3.40 mm of Hg in group A and 14.16 +/- 3.16 mm of Hg in group B. In group A at 1 hr after procedure, mean IOP was 15.84 +/- 3.16 mm of Hg and at 3 hr it was 16 +/- 3.32 mm of Hg also at 24 hrs it was 15.28 +/- 3.46 mm of Hg. Maximum IOP rise ranged between 2 - 10 mm of Hg.

Similarly in group B i.e. no treatment group, mean IOP was 17.2 +/- 4.43 mm of Hg at the end of 1 hr and became 17.6 +/- 3.74 mm of Hg at 3 hrs. At 24 hrs it was noted as 15.52 +/- 3.02 mm of Hg.

In group A mean IOP elevation is 1.12 mm of Hg at 1 hr, 1.28 mm of Hg at 3 hrs and 0.56 mm of Hg at 24 hrs after laser capsulotomy.

Likewise, in group B average elevation in IOP is 3.04 mm of Hg at 1 hr, 3.28 mm of Hg at 3 hrs and 1.76 mm of Hg at the end of 24 hrs. maximum IOP elevation seen was in the range of 2 - 18 mmHg from the baseline. The rise in IOP without prophylactic treatment is statistically significant as on applying unpaired t-test, p value came to be < 0.05 for IOP at 1 and 3 hours thus rejecting null hypothesis and making the results significant, with P value for pressure elevation at 1 hr is 0.007 and at 3 hr it is 0.0009. In the above table we can appreciate the blunting effect on the IOP spikes in the treatment group.

With increasing grade of PCO, reduction in IOP became lower. Also, less the energy used more was the reduction in post laser IOP and vice versa.

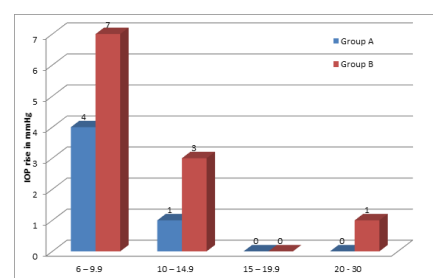
GRAPH 6 IOP PATTERN IN GROUP A AND GROUP B**TABLE 7 DISTRIBUTION OF CASES WITH SIGNIFICANT IOP ELEVATION**

S no.	Maximum IOP rise at any of the following visit	No. Of cases in group A	%	No. Of cases in group B	%
1.	6 - 9.9	4	8	7	14
2.	10 - 14.9	1	2	3	6
3.	15 - 19.9	0	0	0	0
4.	20 - 30	0	0	1	2
TOTAL	5	10	11	22	

The above table shows an overall incidence of IOP rise in 16 (32%) patients. out of these, most of the patients (22%) suffered from maximum IOP rise of 6 - 9.9 mm of Hg i.e. 11 out of 16. One patient suffered from an acute rise of IOP of 30 mm of Hg.

GRAPH 7

Distribution of cases with significant IOP elevation



DISCUSSION

Currently Nd:YAG laser capsulotomy is the ultimate treatment for PCO, and as it is non-invasive, safe, less time consuming as compared to surgical capsulotomy, it has gained popularity over the last few decades. But, it is not devoid of complications such as intraocular lens pitting, corneal burns and raised IOP. This rise in IOP, although transient, can cause glaucomatous damage if spikes beyond 10 mmHg. In this study, we have focused on IOP changes following Nd:YAG laser capsulotomy with and without prophylactic treatment with 0.5 % Timolol maleate.

According to various studies done earlier, it has been found that timolol maleate 0.5 % was effective in blunting off the IOP spikes occurring after Nd:YAG laser posterior capsulotomy (5,6,7, 8, 9,10) as are various other ocular hypotensive drugs (11). In other study, it was quoted that timolol maleate did help in decreasing the IOP further down from baseline although nominally (12). Also, in some other notable work it was quoted that despite pre treatment with timolol and acetazolamide, IOP increased for the first 24 hrs and returned to precapsulotomy levels after several days (4).

In our study in both groups IOP elevation is seen and this elevation is less so when prophylactic timolol maleate 0.5 % is given as in group A. In treatment group (group A) maximum IOP rise occurred in the range of 2-10 mmHg and in non-treatment group (group B), in the range of 2-18 mmHg. The IOP rise in group B was significant at 1 hr and 3hrs (P value < 0.05) after laser capsulotomy opposed to group A. However IOP elevation at 24 hrs post laser capsulotomy was insignificant in both the groups. Apart from this, it was found that rise in IOP is also affected by grade of PCO, duration of PCO formation and also the amount of energy used (5). In our study relation between IOP and higher energy levels were found to be insignificant similar to study done by Flohr MJ et al and Waseem M et al. (13,14)

Timolol 0.5% is effective in blunting off the IOP spikes following Nd:YAG capsulotomy. Also shown by, Altamirano D et al; Rafofsky S et al and Cai JP et al. (2,9,10) it was quoted that timolol maleate did help in decreasing the IOP further down from baseline although nominally. (12)

CONCLUSION

Thus, based on the results of this study I conclude that a transient IOP rise occurs after capsulotomy particularly between 1-3 hours and returns to baseline within 24 hours. However this pressure rise can be controlled by using prophylactic timolol 0.5 % one hour prior to laser treatment. So, it can be used to prevent IOP rise.

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