Factors Affecting IOP Changes Following Neodymium: Yttrium Aluminum GARNET (Nd:YAG) Capsulotomy

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ABSTRACT

Introduction: Transient intraocular pressure rise is a commonly observed phenomenon following Nd:YAG capsulotomy. However, IOP change is considered to be dependent on multiple factors. Study aimed to assess factors determining the IOP change following Nd:YAG capsulotomy.

Material and Methods: A total of 150 adult patients, scheduled to undergo Nd:YAG laser capsulotomy for management of posterior chamber opacification (PCO) were enrolled. Age, gender, time since cataract surgery, PCO grade, IOP, topical hypotensive use was noted in all the cases. Amount of energy used in Nd:YAG procedure was recorded. Postoperative IOP change was noted immediately, 1 hr and 3 hr postoperative intervals. Rise >5 mm was considered clinically significant. Independent samples 't'-test, Chi-square test and binary logistic regression were used. Data analysis was performed using SPSS 15.0 software.

Results: Mean age of patients was 60±11.3 years. Majority were females (59.3%). Majority of patients had Grade I and II of PCO (64%), 5-10 years duration since cataract surgery (79.3%) and topical hypotensive use was done(58%). Preoperative mean IOP was 15.99±2.72 mmHg. Energy used was 55.7±52.7 mJ. A total of 19 (12.7%) patients had IOP rise >5 mm. On univariate analysis, Grade III or above PCO, higher level of total energy use and low hypotensive use were found to be significantly associated with IOP rise. On multivariate assessment, low hypotensive use and high energy use were found to be significantly associated with clinically significant IOP rise ($p<0.05$).

Conclusions: Low energy and prophylactic topical hypotensives were protective against IOP rise.

Keywords: Intraocular Pressure Rise, Nd:YAG Capsulotomy, Topical Hypotensives, Energy Used.

INTRODUCTION

Posterior capsule opacification (PCO, after cataract), which is also termed as secondary cataract, is considered to be the most common sequelae following cataract surgery.[1,2] PCO can impair the vision substantially and in turn could affect the quality of life of affected patients. In order to restore the proper vision lost due to PCO, it is essential that removal of PCO should be done at the earliest.[3] Earlier the removal of PCO involved manual surgical procedures that themselves had a number of associated complications, however, in the recent years Nd:YAG laser capsulotomy has emerged as one of the most effective non-invasive measures of PCO removal.[4-6] Despite its non-invasive nature and relatively safer profile, use of laser energy has been indicated to be associated with some complications.[7,8] Among different complications associated with Nd":YAG capsulotomy, a transient rise in intraocular pressure is one of the most important ones.[7-10] A number of explanations have been provided for this transient rise in IOP such as the deposition of debris in the trabecular meshwork, pupillary block and inflammatory swelling of the ciliary body.[11] The increase in IOP noted is 5-10 mm of Hg and may lead to serious eye damage.[12] Low energy use and topical hypotensive use have been indicated to be associated with reduced risk of IOP rise following Nd:YAG laser capsulotomy.[13-15] Size/Grade of PCO[16], Myopia, a history of retinal detachment in the other eye, younger age, and male sex have also been reported as risk factors for complications following Nd:YAG laser posterior capsulotomy.[17] One of the interesting thing is that extent of IOP rise following Nd:YAG laser posterior capsulotomy is not uniform in all the patients and there is an extreme variability in range of IOP increment, thus depicting that this IOP rise is dependent on patient or procedural variables. Unfortunately, despite a large pool of literature regarding IOP rise following Nd:YAG capsulotomy, there are limited studies exploring the factors responsible for clinically significant IOP change. In present study we made an attempt to address this problem.

MATERIAL AND METHODS

The study was conducted in post cataract surgery patients reporting with posterior capsule opacification at the Ophthalmology Outpatient Department of Rohilkhand Medical College and hospital, Bareilly. A total of 150 patients undergoing Nd-YAG laser capsulotomy were enrolled in the study. At enrolment the demographic details of the patients and time since cataract surgery was noted. All the patients underwent complete ocular examination including slit lamp examination. Grading of PCO was done using morphologic scoring system described by Tetz *et al.*[18] Pre-procedure Intraocular pressure (IOP) was measured using applanation tonometer. Patients having preoperative IOP >35 mmHg were excluded from the study. History of topical hypotensive use (0.5% Timolol maleate) within 2 hrs prior to procedure was also noted.

Procedure

The patient was shifted to laser room which was dimly lit to

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improve surgeon's visualization of the target and consequent accurate focusing. After instillation of topical anesthetic 4% Paracaine, a wide field special Nd.YAG laser contact lens (Abraham's contact lens) was placed over the cornea with viscoelastic substance as coupling agent. The Slit lamp beam was narrowed and obliquely angled (this helps to reduce miosis). Initially Laser shots with low energy (1mJ) were given and gradually increased as per requirement. Aim was to create a 2-3 mm diameter opening in the centre of the opacified capsule with least number of laser spots. This was created by starting from 12º'clock and progressing towards 6º'clock then progressing laterally from central edges of initial vertical opening towards 3 o'clock and 9 o'clock. The residual posterior capsular flaps present in pupillary area were directly fired with laser shots to cut them so that they retract and fall back towards periphery. The patients were subjected to intraocular pressure measurements in mm of Hg on applanation tonometer every immediately, 1hr and 3hrs after capsulotomy. A rise of 5 mm Hg from baseline IOP was considered as clinically significant.

No additional medical therapy was given to any patient unless IOP rose by 5mmHg above the baseline IOP, and if so, 0.5% timolol maleate was advised twice daily for at least 1 day until the IOP dropped to normal.

STATISTICAL ANALYSIS

The data was analyzed using Statistical Package for social sciences version 15.0. Independent samples "t"-test and has been used to compare the data. Chi-square test has been used to compare the proportions. Binary logistic regression was performed. The confidence level of the study was kept at 95%, hence a "p" value less than 0.05 indicated a statistically significant intergroup difference.

RESULTS

Age of patients ranged from 35 to 86 years. Mean age of patients was 60.0±11.3 years. Majority of the patients were females (59.3%). Only 3 (2%) patients had gap between cataract surgery and PCO formation <5 years, however, majority (79.3%) had the gap of 5-10 years while 28 (18.7%) had the gap of >10 years. Maximum number of patients had PCO grade II (35.3%) followed by grade I (28.7%), grade IV (19.3%) and grade III (16.7%) respectively. Pre-procedure IOP was recorded between 10 to 24 mmHg range. Mean pre-procedure IOP was 15.99±2.72 mmHg. History of topical hypotensive use ≤2 hours prior to procedure was reported by 87 (58%) patients. Mean energy used for the procedure was 55.64±52.69 mJ. Mean IOP values were 17.69±4.70 mmHg, 16.61±3.65 mmHg and 15.78±3.03 mmHg respectively at immediate, 1 hr and 3 hr post-procedure intervals. Mean IOP at immediate and 1 hr post-procedure intervals was significantly higher as compared to baseline IOP. During the post-procedure follow-up a total of 19 (12.7%) patients showed IOP rise >5 mmHg (Table 1).

On univariate analysis, no significant association of clinically significant IOP rise was observed with age, gender, duration since cataract surgery and preoperative IOP. However, greater use of energy, topical hypertensive use history and grade of PCO were significantly associated with clinically significant IOP rise. Proportion of those with Grades III & IV of PCO was significantly higher among patients with clinically significant IOP rise (73.7%) as compared to that in patients not having clinically significant rise (30.6%) (p<0.001). Similarly, energy use of <30 mJ and 30-60 mJ was 39.7% and 32.8% respectively among those without clinically significant IOP rise as compared to 0% and 15.8% only among those with clinically significant IOP rise (p=0.004). History of topical hypotensive use was much lower among those with clinically significant IOP rise (21.0%) as compared to those without clinically significant IOP rise (62.6%) (p=0.001) (Table 2).

On multivariate analysis using binary logistic regression to evaluate the impact of topical hypotensive use, grade of PCO (grade 3 or above), amount of energy used (>60 mJ) and

SN	Characteristic	Statistic
1.	Mean Age±SD (Range) in years	60.0±11.3 (35-86)
2.	Gender	
	Male	61 (40.7%)
	Female	89 (59.3%)
3.	Time since cataract surgery	
	<5 years	3 (2.0%)
	5-10 Years	119 (79.3%)
	>10 Years	28 (18.7%)
4.	PCO Grade	
	I	43 (28.7%)
	II	53 (35.3%)
	III	25 (16.7%)
	IV	29 (19.3%)
5.	Mean Preoperative IOP ±SD (Range) in mmHg	15.99±2.72 (10-24)
6.	Topical hypotensive use	87 (58.0%)
7.	Mean energy used for procedure±SD (mJ)	55.64±52.69
8.	Mean Imm. Post-op. IOP±SD	17.69±4.70*
9.	Mean 1 hr Post-op. IOP±SD	16.61±3.65*
10.	Mean 3 hr Post-op. IOP±SD	15.78±3.03
11.	No. of patients showing significant IOP rise (>5 mmHg) during any post-operative period	19 (12.7%)
*Significant as compared to Preoperative IOP		

Table-1: Demographic Profile, Baseline, Intraoperative and Postoperative Profile of patients (n=150)

SN	Factors	IOP Rise ≤5 mmHg (n=131)	IOP Rise >5 mm Hg (n=19)	Statistical significance
1.	Mean Age±SD (Years)	58.84±11.48	61.05±9.82	't'=0.437; p=0.662
2.	Gender Male Female	 54 (41.2%) 77 (58.8%)	 7 (36.8%) 12 (63.12%)	÷²=0.132; p=0.716
3.	Time since cataract surgery ≤10 Years >10 Years	 108 (82.4%) 23 (17.6%)	 14 (73.7%) 5 (26.3%)	÷²=0.838; p=0.360
4.	Grade of PCO I & II III & IV	 91 (69.6%) 40 (30.6%)	 5 (26.3%) 14 (73.7%)	÷²=13.4; p<0.001
5.	Total Energy used <30 mJ 30-60 mJ 60-90 mJ >90 mJ	 52 (39.7%) 43 (32.8%) 25 (19.1%) 11 (8.4%)	 0 (0%) 3 (15.8%) 8 (42.1%) 8 (42.1%)	÷²=27.99; p=0.004
6.	Topical hypotensive use	82 (62.6%)	4 (21.0%)	÷²=11.71 p=0.001
7.	Preop. IOP ≤18 mm Hg >18 mm Hg	 109 (83.2%) 22 (16.8%)	 16 (84.2%) 3 (15.8%)	÷²=0.012; p=0.913

Table-2: Factors associated with significant post-procedure change in IOP (>5 mmHg)

Determinant factor	OR (Exp. â) (95% CI)	'p'
Hypotensive use	0.179 (0.05-0.63)	0.008
Grade 3 or above	2.388 (0.685-8.31)	0.171
Total energy >60 mJ	9.596 (2.383-38.64)	0.001
Preop. IOP >18 mmHg	.871 (0.185-4.09)	0.861
Constant	0.051	<0.001

Table-3: Multivariate Binary logistic regression

preoperative IOP (>18 mmHg), only topical hypotensive use (OR=0.178; 95% CI 0.05-0.63; p=0.008) and Total energy use (OR=9.596; 95% CI 2.383-38.64; p=0.001) were found to be significantly associated with clinically significant IOP rise (Table 3).

DISCUSSION

In present study, clinically significant IOP rise was observed in only 19 (12.7%) patients. Compared to present study, Channell and Beckman (1984)[19] in their study reported IOP rise ≥5 mmHg in 61-64% of eyes within 4 hrs post-operative period following Nd:YAG capsulotomy. Relatively much lower incidence of clinically significant IOP rise in present study could be attributable to the better Nd:YAG laser technology available that enables the efficient use of energy. In present study, average use was only 55.64±52.69 mJ as compared to 89.0 mJ in their study. Though, the incidence of 5 mm or above of IOP rise was quite high in the studies conducted in 1980s and 90s[20,21], the incidence has reduced to a much lower level in the contemporary years. In a 2004 study, Barnes *et al.*[22] reported this incidence to be only 20.7% whereas in a more recent study, Patel *et al.*[23] found IOP rise of >5 mm in only 5% of patients in their study. The reason for relatively lower incidence of IOP rise in our study could also be attributable to a high percentage of patients (58%) receiving topical hypotensive prior to laser procedure.

In present study, on univariate assessment, no significant association of age, gender and time since cataract surgery was observed on incidence of clinically significant IOP rise. On reviewing the literature, we find that these factors have hardly been identified as the risk factors associated with IOP rise in otherwise healthy patients. In present study, no impact of preoperative IOP was seen on the IOP rise. One of the reasons for this could be the exclusion of patients with extraordinarily high preoperative IOP from the study. However, we found that grade of PCO, topical hypotensive use and amount of energy used for the procedure were significantly associated with incidence of clinically significant IOP rise. But on multivariate analysis only topical hypotensive use and amount of energy use were found to have a significant association with IOP rise. The association between amount of energy used and IOP rise has been the mainstay of development of Nd:YAG laser technology over the years. The phenomenal decrease in incidence of clinically significant IOP rise in recent past is attributable to the energy-efficient Nd:YAG use. A number of previous studies have showed that low energy use could have a protective effect on IOP rise as observed in present study.[13,19,20,24,25] As far as association between grade of PCO on univariate assessment is concerned, a similar association was also depicted by Shaikh *et al.*[26] in their study, however, it might be associated with the amount of energy use as the patients with higher grades of PCO had larger size and difficult to resolve PCO that required multiple shots of Nd:YAG laser which in turn was responsible for larger amount of energy use. Owing to this cross-relationship in multivariate assessment, the effect of grade of surgery was regressed. On the other hand, the emergence of topical hypotensives as protective agents against clinically significant rise in IOP has been well documented in previous studies too.[20,24,25,26]

CONCLUSION

The findings of present study revealed that efficient use of energy and prophylactic use of topical hypotensives could play a significant role in reducing the incidence of clinically significant IOP rise among patients undergoing Nd:YAG laser posterior capsulotomy and these should be the key considerations while planning the Nd:YAG laser capsulotomy procedures.

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