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The Effects Of Nd: Yag Laser Capsulotomy On Intraocular Pressure In Diabetic Patients

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Abstract

Objective: To determine the mean intraocular pressure (mean IOP) changes after Nd: YAG laser capsulotomy for posterior capsule opacification (PCO) and to compare IOP in diabetic and non-diabetic patients after Nd: YAG laser capsulotomy.

Methods: Total 200 patients of all genders between 26 and 60 years of age who have undergone cataract surgery within 6 months to 3 years prior were included and were treated with minimum possible pulses of Nd: YAG with an energy of 1-13 ml/pulse and capsulotomy with an opening of 3.0-4.0mm of diameter in posterior capsule. After the laser, the intraocular pressure was measured at 1 hour, 2 hours, 4 hours and 24 hours. An independent t-test was used to compare the mean intraocular pressure between two groups at first hour, 2 hours, 4 hours, 24 hours and one week time points. A paired t-test was used to compare the mean difference in IOP from baseline at each post-Laser interval in each group, respectively.

Results: Out of 200 patients (200 eyes), 100 patients (50%) were diabetic and 100 patients (50%) were non-diabetic. The mean pre-laser IOP was 14.72 ± 2.67 in the diabetic group and 14.36 ± 1.47 in the non-diabetic group. At one hour after laser treatment, the mean IOP was 19.17 ± 3.16 in the diabetic group and 15.62 ± 2.33 in the non-diabetic group, with p p-value of 0.0001. Mean intraocular pressure difference at 1st hour is 3.55 mmHg in the diabetic group, which is significantly higher than that in the non-diabetic group, which is 1.26 mmHg.

Conclusion: This study concluded that IOP rises at the 1st and 2nd hour after Nd: YAG capsulotomy, and after that it gradually decreases to prelaser values after 24 hours. The mean intraocular pressure difference at 1st hour in the diabetic group is significantly higher than that in the non-diabetic group.

Keywords: Posterior capsular opacification, Nd-YAG laser capsulotomy, intraocular pressure.

Introduction

Posterior capsule opacification (PCO), also called the “after cataract” or “secondary cataract,” is the most common late postoperative complication after cataract surgery.[1] Diabetic patients undergoing cataract surgery are prone to a greater number of postoperative complications. Diabetic patients have been reported to develop significantly greater PCO after cataract surgery than nondiabetic patients; however, the stage of retinopathy and the systemic status of diabetes did not correlate with the degree of PCO.[2]

The current treatment of choice for PCO is neodymium-doped yttrium-aluminium-garnet (Nd: YAG) laser Capsulotomy. It is an effective, safe, cost-effective and noninvasive procedure which uses a photo-disruptive laser to disrupt tissue. This property of the Nd YAG Laser is used to disrupt the posterior lens capsule, thus creating an opening in it, which causes a significant improvement in visual acuity. Although recent modifications in surgical techniques, IOL material, and designs have reduced the PCO rate, it is still a considerable problem following cataract surgery.

Contributions:
S.U, M.Z, A.J, M.M, F.A.K.N - Conception of study - Experimentation/Study Conduction
W.R, M.M, - Analysis/Interpretation/Discussion
S.U, W.R - Manuscript Writing
M.Z, A.J, M.M - Critical Review

All authors approved the final version to be published & agreed to be accountable for all aspects of the work.

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While doing Nd: YAG Laser capsulotomy, some complications can be encountered, like a rise in intraocular pressure, inflammation in the eye and retinal problems like cystoid macular oedema and RD. Intraocular pressure is the most common complication.[3]

The trends of intraocular pressure changes over time following the YAG laser capsulotomy have been studied. A study in India showed that intra ocular pressure before laser capsulotomy was 14.45±2.52 which increased up to 16.08 ± 3.69, 16.83± 3.69 one and two hours respectively after the Nd: YAG Laser capsulotomy while, it subsequently returns to the pre laser values, i.e at 24 hours and 1 week mean IOP was recorded to be 15.11 ± 2.55 and 14.58 ± 2.52 respectively. The same study shows that within 2 hours, 80% of patients report an increase in intraocular pressure, while between 2-4 hours post laser, 16% of patients report a rise in intraocular pressure. At the same time, no elevation is seen weeks and one month after the laser procedure, indicating changes in intraocular pressure are of short-term duration.[4]

A study in India shows that the mean intraocular pressure in diabetic groups is 17. 71 ± 0.11 is significantly higher than the non-diabetic group, 14.56 ± 0.23. They divided their cases into two groups. Group I included 80 age- and sex-matched normal healthy participants, constituting the control group. Group II consisted of 100 diabetic patients. Group II was further subdivided into 3 subgroups according to glycemic control: Group IIA consisted of 36 patients diagnosed with Type II diabetes mellitus with hemoglobin A1c (HbA1C) levels <7% indicating good glycemic control, Group IIB consisted of 34 patients diagnosed with Type II diabetes mellitus with HbA1C levels between 7% and 8% indicating fair glycemic control, and Group IIC consisted of 30 patients diagnosed with Type II diabetes mellitus with HbA1C levels >8% indicating poor glycemic control. The mean IOP of patients in Group II was higher than Group I ($P < 0.005$). The mean IOPs of group IIA, IIB and IIC were 16.9±0.43 mm of Hg,17.6±0.62 mm of Hg and 18.62±0.22 mm of Hg, respectively. Patients with poor glycemic control had a higher IOP.[5] Due to the weakness of the blood-aqueous and blood-retinal barrier, it is expected that the rise in IOP would be greater in patients with diabetes.

Not much literature is available that prospectively evaluates the intraocular pressure (IOP) changes in diabetic and nondiabetic patients after Nd: YAG laser posterior capsulotomy.

If the results showed that in our setting, IOP rise after Nd: YAG capsulotomy is greater in diabetic patients as compared to that in non-diabetic patients, then we can make a protocol of giving intensive IOP lowering drugs to diabetic patients to counter IOP rise after YAG Capsulotomy, we can apply LASER in two sessions to minimize energy given per session and hence minimizing IOP rise in each session.

Materials And Methods

This was a Descriptive case series done in the department of Ophthalmology, Benazir Bhutto Hospital, Rawalpindi, a tertiary care setting in Rawalpindi from 30th November 2019 to 29th May 2020. The total sample size was 200 cases, which was calculated from the WHO calculator [4]. Non-probability, consecutive sampling was done. Inclusion criteria were patients who had undergone cataract surgery at least 6 months earlier but <3 Years had PCO on SLIT lamp examination with age >25 and <60 years. Both males and females were included. Patients with Type 2 diabetes were included. Patients with other ocular pathology (eg. Corneal opacity, glaucoma, Uveitis, posterior segment pathology), patients with history of trauma, patients with history of ocular surgery other than cataract surgery, patients with history of systemic disease other than diabetes which could interfere with ocular structure, type 1 diabetics and patients with duration since cataract surgery >3 years were excluded.

After approval from the ethical review committee, the study was conducted in the ophthalmology department. Complete history and detailed slit lamp examination of anterior and posterior segment was done to grade PCO and to rule out posterior segment pathologies of retina and macula. Patients who were confirmed to have PCO were recruited for the study as per the study selection criteria.

After taking informed consent, YAG Capsulotomy was done after dilation with 1% tropicamide. After the laser, the intraocular pressure was measured at 1 hour, 2 hours, 4 hours and 24 hours after the surgery. The YAG laser energy used was also noted. All the information required for the study was noted on the predesigned questionnaire that included clinical and patients' demographic variables relevant to the study.

Data was entered and analysed in SPSS version 16. Descriptive statistics were calculated for qualitative and quantitative variables. Independent t test was used to compare the mean intra ocular pressure between two groups at first hour, 2 hour, 4 hour, 24 hour and one week time points. Paired t test was used to compare mean difference in IOP from baseline at each post Laser interval in each group.

Results

The age range in this study was from 26 to 60 years, with a mean age of 51.38 ± 5.46 years. The majority of the patients, 164 (82.0%), were between 46 to 60 years of age. Out of these 200 patients, 138 (69.0%) were males and 62 (31.0%) were females, with a male-to-female ratio of 2.2:1. The Mean duration since cataract surgery was 2.01 ± 0.97 years.

A total of 200 patients (200 eyes) were studied, 100 patients (50%) We were diabetic, and 100 patients (50%) were non-diabetic. The mean pre-laser IOP was 14.54 ± 2.7, and the mean post-laser IOPs were 17.39 ± 2.1, 16.79 ± 2.89, 16.54 ± 2.13, 14.57 ± 2.76 and 14.16 ± 1.84 at 1st, 2nd, 4th, 24th hours and one week, respectively, as shown in Table 1. The mean pre-laser IOP was 14.72 ± 2.67 in the diabetic group and 14.36 ± 1.47 in the non-diabetic group. At one hour after laser treatment, the mean IOP was 19.17 ± 3.16 in the diabetic group and 15.62±2.33 in the non-diabetic group (Table 2). Mean intraocular pressure in diabetic groups is significantly higher than the non-diabetic group (19.17 ± 3.16 vs 15.62 ± 2.33; p-value = 0.0001) at 1 hour postlaser. Mean intraocular pressure difference at 1st hour is 3.55 mmHg in the diabetic group, which is significantly higher than that in the non-diabetic group, which is 1.26 mmHg. Figures 1 and 2 show normal distribution curves in non-diabetic and diabetic patients, respectively. The peaks which show the mean pre laser IOP and mean post laser IOP are close together along x axis in non-diabetic patients(Figure:1), while these peaks are far apart in diabetic patients (Figure:2). This far apart of peaks wrt to x-axis shows the relative change is high in comparison to non-diabetic normal distributions.

This shows that the mean IOP rise after laser is greater in diabetic patients in comparison to non-diabetic patients. The normal distribution peaks, which show the mean, while the spread of the bell curve shows the standard deviation, are shown in Figure 2. The graph is plotted for the 200 samples of both diabetic and non-diabetic patients for both pre- and post-laser IOP independently.

Table 1: Mean intraocular pressure (mean IOP) changes after Nd: YAG laser capsulotomy for posterior capsule opacification (PCO) for n=200

Intraocular pressure (mmHg)	Mean	SD
Pre Laser	14.54	2.10
1st hour (Post Laser)	17.39	2.09
2nd hour (Post Laser)	16.79	2.89
4th hour (Post Laser)	16.54	2.13
24th hour (Post Laser)	14.57	2.76
First Week (Post Laser)	14.16	1.84

Table 2: Comparison of Pre-Laser IOP Values vs Post-Laser IOP(after 1 hour) Values in Diabetic and Non-Diabetic Patients

Patient Category	Intraocular pressure (mmHg)		p-value
	Pre-Laser IOP	Post Laser IOP	
Non-Diabetic	14.36 ± 2.147	15.62 ± 2.33	0.0001
Diabetic	14.72 ± 2.67	19.17 ± 3.16	
Mean	14.54 ± 2.1	17.30 ± 2.09	

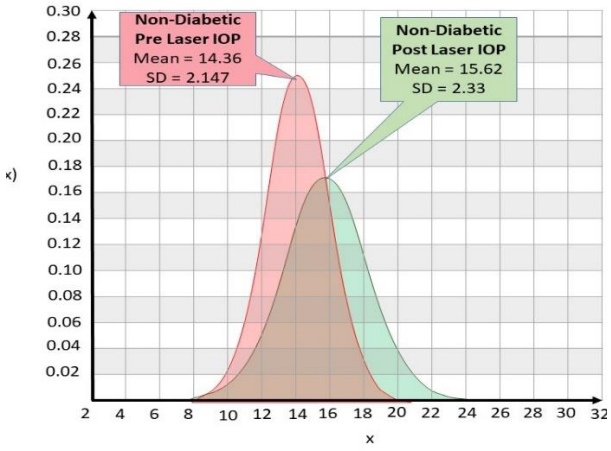

Figure 1: Normal Distribution of Non-Diabetic IOPs Mean & SD before procedure

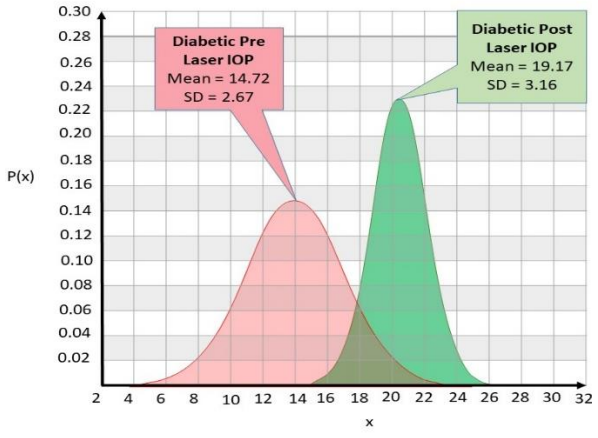

Figure 2: Normal Distribution of Diabetic IOPs Mean & SD before procedure

Discussion

Our results are consistent with a study done in India which showed that intra ocular pressure before laser capsulotomy was 14.45 ± 2.52 which increased up to 16.08 ± 3.69, 16.83± 3.69 one and two hours respectively after the Nd: YAG Laser capsulotomy while, it subsequently returns to the pre laser values, i.e at 24 hours and 1 week mean IOP was recorded to be 15.11 ± 2.55 and 14.58 ± 2.52 respectively.[4]

Another study in India shows that the mean intraocular pressure in diabetic groups is 17. 71 ± 0.11 is significantly higher than the non-diabetic group, 14.56 ± 0.23. They divided their cases into two groups. Group I included 80 age- and sex-matched normal healthy participants, constituting the control group. Group II consisted of 100 diabetic patients. Group II was further subdivided into 3 subgroups according to glycemic control: Group IIA consisted of 36 patients diagnosed with Type II diabetes mellitus with hemoglobin A1c (HbA1C) levels <7% indicating good glycemic control, Group IIB consisted of 34 patients diagnosed with Type II diabetes mellitus with HbA1C levels between 7% and 8% indicating fair glycemic control, and Group IIC consisted of 30 patients diagnosed with Type II diabetes mellitus with HbA1C levels >8% indicating poor glycemic control. The mean IOP of patients in Group II was higher than Group I ($P < 0.005$). The mean IOPs of groups IIA, IIB and IIC were 16.9±0.43 mm of Hg,17.6±0.62 mm of Hg and 18.62±0.22 mm of Hg, respectively. Patients with poor glycemic control had a higher IOP. The difference in IOP was found to be statistically significant ($P < 0.005$).[5]

Though reliable, Nd: YAG capsulotomy can lead to complications like a spike in IOP, IOL pitting and cracks, change in refraction, macular oedema, retinal tear, and retinal detachment.[6-9,16] Among all the complications, a rise in IOP is the most common one.[3] In one study, Shams and Narain revealed that the mean pre-operative IOP was 13.28. At 2 hours, mean IOP was 16.84±3.63 mmHg and after one week, 12.48±2.0 mmHg, which showed a significant short-term increase in IOP post-procedure, with a return to near baseline levels after one week.[10]

A study in Iraq showed that there was a statistically significant ($p < 0.001$) rise in IOP at one hour in both aphakic and pseudophakic groups from a mean of 12.54 mmHg before laser to a mean of 20.79 mmHg, with an average of 8.35 mmHg from baseline measurement.[11] In another study, Varghese and Mariam Mercy revealed a significant initial rise in IOP post-procedure, which returned to near baseline levels within one week.[12]

A study in India evaluated the visual outcomes and intraocular pressure (IOP) changes following Nd- YAG laser capsulotomy in 100 patients with posterior capsular opacification, comparing diabetics and non-diabetics. Results showed significant visual acuity improvement in both groups, with better outcomes in non-diabetics, and a transient rise in IOP returning to near baseline levels by four weeks [13]

In comparison, the results of these studies with our result they all It coincides that the rise in IOP after Nd-Yag LPC is a major issue and must be treated prophylactically to control the spike in IOP after laser. The rise is greater in diabetic patients than in non-diabetic patients. However, one conflicting study was found. Ozkurt et al,[14] concluded no significant change in IOP after Nd: Yag capsulotomy. In [15], authors reported 26 cases of posterior capsular opacification, with an average of 53.73 ± 13.53 years, and the Nd: YAG capsulotomy showed substantial changes in visual acuity from 0.38 ± 0.13 to 0.93 ± 0.11. The s (equation) refraction remained nearly constant with a small change from -0.52 D to -0.49 D. There were no differences in the anterior chamber depth or the intraocular pressure after treatment, as reported by the results.

The limitations of this study are that the variation in the thickness of PCO leads to different energy levels required to do capulotomy, resulting in variation in post-laser IOP. The thicker the PCO, the greater the amount of energy used, the greater the IOP change. This leads to a confounding effect. In addition, a larger sample size would be more conclusive. Moreover, expansion of the study to see the effect of blood glucose levels, HbA1c, duration of diabetes and associated stage of retinopathy on IOP change after laser in diabetic patients is needed.

Conclusions

Based on results, it can be concluded that IOP rises at the 1st and 2nd hour after Nd: YAG capsulotomy, and after that it gradually decreases to prelaser values after 24 hours. The mean intraocular pressure difference at 1st hour in the diabetic group is significantly higher than that in the non-diabetic group.

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