

Original Research Article

Variability of IOP following laser photocoagulation used in the treatment of diabetic retinopathy

Sangeeta Agarwal¹, Amit Kumar Patel^{2*}, Ramyash Singh Yadav³,
Ram Kumar Jaiswal³, Shweta Goel²

¹Department of Ophthalmology, Government Medical College, Azamgarh, Uttar Pradesh, India

²Department of Ophthalmology, MRA Medical College, Ambedkarnagar, Uttar Pradesh, India

³Department of Ophthalmology, B.R.D Medical College, Gorakhpur, Uttar Pradesh, India

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*Correspondence:

Dr. Amit Kumar Patel,

E-mail: njmsonline@gmail.com

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ABSTRACT

Background: Diabetic retinopathy (DR) is the leading cause of blindness in most industrialized countries. This study was undertaken to assess the variability of IOP following laser photocoagulation used in the treatment of diabetic retinopathy.

Methods: This study was conducted at Department of Ophthalmology, B.R.D. Medical College, Gorakhpur from June 2015 to December 2016. This study was intended to see the onset and duration of intraocular pressure spikes in diabetic retinopathy patients after green laser photocoagulation (532 nm) (Nidek). Forty patients were followed for next 3 months. The data was analysed by using SPSS version 15.0. Chi-square test and T test was used.

Results: Out of 40 patients, 2 (5%) had background Diabetic retinopathy (DR) with maculopathy, 10 (25%) having pre-proliferative DR, 28 (70%) having proliferative DR. Out of 2 BDR patients, 1 (50%) developed immediate post laser angle closure (Schaffer's grade 1) which persisted for 3 days and another had shown no change in angle structure. Out of 10 PPDR patients, no one developed post laser angle closure (0%). Out of 28 PDR patients, 6 (21.4%) had post laser angle closure which included 4 patients who had angle closure before laser, that means around 7% patients developed angle closure in this group. Among these 2 patients, 1 developed angle closure immediately (Schaffer's grade 1) and another developed the same 1 day later and this angle closure (Schaffer's grade 1) remained for 3 days.

Conclusions: Laser photocoagulation in diabetic retinopathy patients can cause increase in IOP.

Keywords: DR, IOP

INTRODUCTION

Diabetic retinopathy (DR) is the leading cause of blindness in most industrialized countries. Vast majority of diabetic individuals lose their vision just because of delay in seeking medical attention.¹ The proper treatment of DR includes proper and timely fundus examination, strict glucose control and laser therapy along with vitrectomy. In accordance with recommendations of Early Treatment Diabetic Retinopathy Study (ETDRS)

fundus examination should be started as early as possible and to be repeated periodically in order to decrease the chance of developing subsequent diabetic macular edema or neovascularization, so that the risk of severe visual loss will be less than 5%.¹ The best predictor of diabetic retinopathy is the duration of disease.² The first 5 years of type 1 diabetes has very low risk of retinopathy. However, 27% of those who have had diabetes for 5-10 years and 71%-90% of those who have had diabetes for longer than 10 years have diabetic retinopathy.³ The

Diabetic Retinopathy Study (DRS) proved that panretinal photocoagulation (PRP) significantly decreases the likelihood that eye with high risk characteristics (HRC) progress to severe visual loss.⁴ The goal of PRP is to arrest or to cause regression of neovascularization. The PRP has significant complications like decreased visual acuity by causing macular edema or macular pucker and sometimes it causes transient rise of intraocular pressure (IOP) which may last for 1-2 weeks.^{5,6}

Fortunately, edema subsides but visual field usually is moderately but permanently decreased. After extensive laser photocoagulation of the retina elevation of IOP is found. Most of the patients have open anterior chamber angle and a very few patients have a closed angle initially or later in the course of the pressure elevation. The mechanism of pressure elevation is thought to be angle closure secondary to swelling of ciliary body or because of an outpouring of fluid from choroid to the vitreous with subsequent forward displacement of lens-iris diaphragm.⁷ Transient IOP rise also occurs after either argon or Nd:YAG laser iridotomy.⁸

The IOP rise is caused by a reduction in outflow facility. Amount of the total energy delivered has influence on this transient IOP rise.⁹

Nd:YAG laser posterior capsulotomy also causes transient rise of IOP. Risk factors for significant IOP elevation includes preexisting glaucoma, larger capsulotomy, sulcus fixated PCIOL, absence of PCIOL, myopia, vitreoretinal disease etc.¹⁰ The mechanism of IOP elevation may be the obstruction of trabecular meshwork by fibrin and inflammatory cells due to breakdown in blood-aqueous barrier or debris from the capsule or cortical remnant.⁹

Patients with open angle or angle closure glaucoma or glaucoma suspects with co-existing DR also come for laser treatment and these patients are prone to have increased risk of post laser IOP spikes. At the initial stages of glaucoma, the IOP often remains normal.

A single reading of intraocular pressure if normal is therefore of no value, since this may coincide with temporary fall to basal pressure which may be within normal range. A variation in the IOP over 6-8 mm Hg should always raise a suspicion of glaucoma, even though the reading may fall within the limits generally accepted as normal (20 mm Hg). This periodic variation in IOP can damage the eye and produce field defects and cupping of the disc particularly when lamina cribrosa is weak.¹¹

There is scarcity of literature regarding variability of IOP following laser photocoagulation used in the treatment of diabetic retinopathy. Few studies were conducted previously and duration of those studies was very short and at the same time number of patients were less and

there was wide age variation and hence this study was undertaken.

METHODS

This study was conducted at Department of Ophthalmology, B.R.D. Medical College, Gorakhpur from June 2015 to December 2016. A total number of 80 patients were screened and examined and out of them 40 patients were selected. This study was intended to see the onset and duration of intraocular pressure spikes in diabetic retinopathy patients after green laser photocoagulation (532 nm) [Nidek]. These 40 patients were followed for next 3 months.

Inclusion criteria

- Patients of background, pre-proliferative, proliferative diabetic retinopathy who required laser treatment
- Patients of diabetic retinopathy requiring laser as a treatment modality who were also having coexisting glaucoma were included.

Exclusion criteria

- Patients having ischemic maculopathy
- Patients of diabetic retinopathy with other systemic disorders or endocrine disorders including thyroid ophthalmopathy
- Patients with High myopia and those with any other ocular diseases including corneal ulcer, uveitis etc.

A detailed history was taken and physical examination was done and data were entered into a proforma. All patients underwent blood pressure evaluation at all visits. Blood pressure was recorded in sitting position in left arm with mercury sphygmomanometer.

All patients underwent following detailed ocular assessment. The fundus findings were graded as:

- Background diabetic retinopathy: Group I
- Pre-proliferative diabetic retinopathy: Group II
- Proliferative diabetic retinopathy: Group III

Moreover, all patients were on full treatment and they were investigated for blood sugar and lipid profile at the time of first visit to our department. These data were filled in proforma.

These patients then underwent green laser photocoagulation (532nm) [Nidek] (focal, grid or pan retinal) under topical anaesthesia (0.25% proparacaine drop). After that we repeated visual acuity, gonioscopy and applanation tonometry at immediate post treatment and hourly interval for 2 hours on the day of treatment and then on first, second post treatment day then on first month, second months, third months, fundoscopy and

fundus fluorescence angiography were repeated after 3 months.

Diagnosis of Diabetes mellitus

According to WHO guideline: fasting blood sugar >126 mg/dl, Post prandial blood sugar >200mg/dl and random blood sugar 200 mg/dl plus classical symptoms of diabetes mellitus. After 3 months of follow up to drop out was noted. After that whole data were noted down.

Statistical analysis is

The data was analysed by using SPSS version 15.0. Chi-square test and T test was used. P-value <0.05 considered as statistically significant.

RESULTS

Total 40 patients were selected and out of these 32 (80%) were below the age of 50 years and 8 (20%) were aged above 50 years. Among above patients, 34 (85%) were males and 6 (15%) were females.

Among the male patients 14 (35%) had duration <5 years, 9 (22.5%) had duration 5-10 years and 11 (27.5%) had duration >10 years. Among the female patients, 5(12.5%)

had duration <5 years and 1 (2.5%) had duration 5-10 years.

Among 40 patients on Preoperative fundus examination, 2 (5%) had BDR with maculopathy, 10 (25%) had PPDR and 28 (70%) had PDR.

Among 40 patients, before laser photocoagulation 36 (90%) had open anterior chamber angle (Schrffer's grade IV) and 4 (10%) had closed angle (Schrffer's grade 0) due to angle neovascularization as determined by the Gonioscope. These had pre-laser high IOP.

Among 40 patients on preoperative angle assessment, 2 (5%) had BDR with maculopathy, 10 (25%) had PPDR and 28 (70%) had PDR.

Among 40 patients, primarily grid or grid followed by PRP was applied in 14 (35%) patients and only PRP was applied in rest 26 (65%) patients.

Out of 2 BDR patients no one had angle closure before laser (0%). The same thing was applicable in 10 PDR patients (0%). But in 28 PDR patients 4(14.3%) had angle closure (Schaffer's grade 0) due to angle neovascularization before laser application. Here p value is 0.386. (Table 1)

Table 1: Comparison of preoperative fundus with preoperative angle (Schaffer's grading).

Preoperative laser angle	Preoperative fundus					
	BDR		PPDR		PDR	
	No.	%	No.	%	No.	%
Open	2	100	10	100	24	85.7
Closed	0	0	0	0	4	14.3
Total	2	100	10	100	28	100

$X^2 = 1.905$; $p = 0.386$

Out of 2 BDR patients, 1 (50%) developed immediate angle closure (Schaffer's grade 1) which persisted for 3 days and another had shown no change in angle structure. Out of 10 PPDR patients, no one developed post laser angle closure (0%). Out of 28 PDR patients, 6 (21.4%)

had post laser angle closure which included 4 patients who had angle closure in this group. Here p value is 0.143. Among these 2 patients, 1 developed angle closure immediately (Schaffer's grade 1) and another developed the same 1 day later and this angle closure (Schaffer's grade 1) remained for 3 days.

Table 2: Comparison of postoperative fundus with postoperative angle (Schaffer's grading).

Postoperative laser angle	Preoperative fundus					
	BDR		PPDR		PDR	
	No.	%	No.	%	No.	%
Open	1	50.0	10	100	22	78.6
Closed	1	50.0	0	0	6	21.4
Total	2	100	10	100	28	100

$X^2 = 3.884$; $p = 0.143$

Here 1 (50%) BDR patient received grid laser and another grid followed by PRP. 3 (21.4%) PPDR received grid followed by PRP and 7 (26.9%) had undergone only

PRP. Out of 28 PDR patients, 10 (71.4%) had undergone grid followed by PRP and rest 18 (69.2%) had undergone only PRP. Here p value is 0.855.

Table 3: Comparison of pre-op fundus with laser.

Preoperative fundus	Laser			
	Grid		PRP	
	Number	%	Number	%
BDR	1	7.1	1	3.8
PPDR	3	21.4	7	26.9
PDR	10	71.4	18	69.2
Total	14	100	26	100

$X^2 = 0.314$; $p = 0.855$

Table 4: Comparison of laser with APTN.

Time interval	APTN	Laser		X^2	p-value
		Grid (n=14)	PRP (n=26)		
0 hour	≤ 10	-	-	1.134	0.287
	11-21	14 (100%)	24 (92.3%)		
	> 21	0	2 (7.7%)		
Immediate	≤ 10	-	7 (26.9%)	8.725	0.013*
	11-21	13 (92.9%)	12 (46.2%)		
	> 21	1 (7.1%)	7 (26.9%)		
1 hour	≤ 10	0	7 (26.9%)	12.627	0.002*
	11-21	13 (92.9%)	9 (34.6%)		
	> 21	1 (7.1%)	10 (38.5%)		
2 hours	≤ 10	0	7 (26.9%)	12.627	0.002*
	11-21	13 (92.9%)	9 (34.6%)		
	> 21	1 (7.1%)	10 (38.5%)		
3 hours	≤ 10	0	7 (26.9%)	12.627	0.002*
	11-21	13 (92.9%)	9 (34.6%)		
	> 21	1 (7.1%)	10 (38.5%)		
1 day	≤ 10	0	3 (11.5%)	4.412	0.110
	11-21	11 (78.6%)	12 (46.2%)		
	> 21	3 (21.4%)	11 (42.3%)		
2 days	≤ 10	0	3 (11.5%)	4.412	0.110
	11-21	11 (78.6%)	12 (46.2%)		
	> 21	3 (21.4%)	11 (42.3%)		
3 days	≤ 10	0	3 (11.5%)	3.033	0.219
	11-21	11 (78.6%)	14 (53.8%)		
	> 21	3 (21.4%)	9 (34.6%)		
1 month	≤ 10	0	0	1.746	0.186
	11-21	14 (100%)	23 (88.5%)		
	> 21	0	3 (11.5)		
2 months	≤ 10	0	0	1.746	0.186
	11-21	14 (100%)	23 (88.5%)		
	> 21	0	3 (11.5)		
3 months	≤ 10	0	0	0.552	0.457
	11-21	14 (100%)	25 (96.2%)		
	> 21	0	1 (2.8%)		

* $p < 0.05$

IOP rise is seen after green laser photocoagulation and statistically significant p value was noted

immediately(p=0.013), 1 hour later (p=0.002), 2 hour later (0.002) and 3 hour later (p=0.002).

Table 5: Comparison of laser with BCVA.

Time interval	BCVA	Laser		X ²	p-value
		Grid (n=14)	PRP (n=26)		
Immediate	Good	-	-	5.692	0.015*
	Fair or same	8 (57.1%)	5 (19.2%)		
	Poor	6 (42.9%)	21 (80.8%)		
1 hour	Good	-	-	5.692	0.015*
	Fair or same	8 (57.1%)	5 (19.2%)		
	Poor	6 (42.9%)	21 (80.8%)		
2 hours	Good	-	-	5.692	0.015*
	Fair or same	8 (57.1%)	5 (19.2%)		
	Poor	6 (42.9%)	21 (80.8%)		
3 hours	Good	-	-	7.766	0.021*
	Fair or same	8 (57.1%)	5 (19.2%)		
	Poor	6 (42.9%)	21 (80.8%)		
1 day	Good	1 (7.1%)	5 (19.2%)	4.275	0.118
	Fair or same	9 (64.3%)	8 (30.8%)		
	Poor	4 (28.6%)	13 (50.0%)		
2 days	Good	2 (14.3%)	5 (19.2%)	4.390	0.111
	Fair or same	9 (64.3%)	8 (30.8%)		
	Poor	3 (21.4%)	13 (50.0%)		
3 days	Good	2 (14.3%)	5 (19.2%)	2.538	0.281
	Fair or same	9 (64.3%)	10 (38.5%)		
	Poor	3 (21.4%)	11 (43.3%)		
1 month	Good	13 (92.9%)	17 (65.4%)	5.421	0.066
	Fair or same	0	8 (30.8%)		
	Poor	1 (7.1%)	1 (3.8%)		
2 months	Good	13 (92.9%)	23 (88.5%)	0.562	0.755
	Fair or same	1 (7.1%)	2 (7.7%)		
	Poor	0	1 (3.8%)		
3 months	Good	13 (92.9%)	23 (88.5%)	0.562	0.755
	Fair or same	1 (7.1%)	2 (7.7%)		
	Poor	0	1 (3.8%)		

*p<0.05

Best corrected visual acuity is diminished after laser application. But significant p value was seen immediately after laser (p=0.015), 1 hour later (p=0.015), 2 hours later

(0.015) and 3 hour later (0.021). Here IOP was measured after laser. But significant p value was noted immediately after application (0.044).

Table 6: Comparison of pre-op fundus and ATPN at different time interval.

Time interval	ATPN	Laser			X ²	p-value
		BDR	PPDR	PDR		
Immediate	≤10	0	0	7 (25.0%)	9.821	0.044*
	11-21	2 (100%)	5 (50.0%)	18 (64.3%)		
	>21	0	5 (50.0%)	3 (10.7%)		
1 hour	≤10	0	0	7 (25.0%)	6.558	0.161
	11-21	2 (100%)	5 (50.0%)	15 (53.6%)		

2 hours	>21	0	5 (50.0%)	6 (21.4%)	6.558	0.061
	≤10	0	0	7 (25.0%)		
	11-21	2 (100%)	5 (50.0%)	15 (53.6%)		
3 hours	>21	0	5 (50.0%)	6 (21.4%)	6.558	0.061
	≤10	0	0	7 (25.0%)		
	11-21	2 (100%)	5 (50.0%)	15 (53.6%)		
1 day	>21	0	0	3 (10.7%)	2.555	0.635
	≤10	0	0	3 (10.7%)		
	11-21	1 (50.0%)	5 (50.0%)	17 (60.7%)		
2 days	>21	1 (50.0%)	5 (50.0%)	8 (28.6%)	2.555	0.635
	≤10	0	0	3 (10.7%)		
	11-21	1 (50.0%)	5 (50.0%)	17 (60.7%)		
3 days	>21	1 (50.0%)	5 (50.0%)	8 (28.6%)	4.000	0.406
	≤10	0	0	3 (10.7%)		
	11-21	1 (50.0%)	5 (50.0%)	19 (67.9%)		
1 month	>21	1 (50.0%)	5 (50.0%)	6 (21.4%)	1.390	0.499
	≤10	-	-	-		
	11-21	2 (100%)	10 (100%)	25 (89.3%)		
2 months	>21	0	0	3 (10.7%)	1.390	0.499
	≤10	-	-	-		
	11-21	2 (100%)	10 (100%)	25 (89.3%)		
3 months	>21	0	0	3 (10.7%)	0.440	0.803
	≤10	-	-	-		
	11-21	2 (100%)	10 (100%)	27 (96.4%)		
	>21	0	0	1 (3.6%)		

DISCUSSION

By the year 2030, about 440 million people in the age-group 20-79 years are estimated to be suffering from diabetes mellitus worldwide (prevalence 7.7%), while in 2010 there were 285 million people with diabetes mellitus (prevalence 6.4%).¹²

Diabetic retinopathy is one of the dreadful complications of diabetes mellitus and if not treated in proper time can lead to irreversible diminution of vision, visual handicap or even total blindness.¹³ Basically, it is a microvascular complication of diabetes and incidence of it is increasing because of increasing life expectancy of patients.

The first line of treatment is control of blood glucose level. If it is not controlled by above measure, then comes the role of laser photocoagulation along with vitrectomy. Laser photocoagulations is still the standard treatment option of the PPDR, PDR, CSME. However, laser photocoagulation if used judiciously may improve the visual status and at least improve the prognosis by limiting the disease process considerably, and its injudicious use may lead to deterioration of vision and deterioration of colour vision and contrast sensitivity. In this study, we have studied the pattern of the onset of IOP rise and its duration after laser photocoagulation, its relationship with type and amount of laser, status of anterior chamber angle both pre-and post-laser. In this study, majority of patients were aged below 50 years and were males. This reflects that now people are affected

with diabetes in relatively earlier age and at the same time they come to hospital and are seeking treatment early compared to past. The reason for male predominance may be that in country like India, females seek medical attention when disease process becomes relatively advanced. This may be due to poor literacy rate among females.

In this study, we have found that transient IOP rise occurs following retinal green laser photocoagulation except in few cases where IOP fall was noted. In some cases, after laser photocoagulation anterior chamber angle was closed which remained so for about 2-3 days. The results are very much similar to results reported by Mensher et al and Blondeau et al (Table 7).^{7,14}

From the above comparison between Blondeau et al and the present study, it is seen that number of patients were more in the present study and 4 patients with angle neovascularization were included in the present study too.¹⁴

Immediately after laser, 24 patients with open angle and normal IOP were found in the present study in contrast to 1 patient in Blondeau study. Moreover, 4 patients with open angle and IOP fall was also noted in the present study.

Hours after laser photocoagulation only 1 patient developed angle closure in the present study in contrast to 5 patients in Blondeau study.

In the Mensher study 30 patients were included in which, 10 developed angle closures and 20 developed narrow

angle after laser photocoagulation.¹⁴

Table 7: Comparison of this study with prior studies.

Variables	Mensher et al ⁷	Blondeau et al ¹⁴	Present study
Number of patients	18	30	40
Before laser	30 patients with open angle and normal IOP	18 patients with open angle and normal IOP	36 patients with normal IOP and open angle 4 patients with closed angle and high IOP
Immediately after laser		14 patients with open angle and high IOP. 1 patients with open angle and normal IOP 3 patients with closed angle and high IOP	6 patients with open angle and high IOP 24 patients with open angle and normal IOP 6 patients with closed angle and high IOP 4 patients with open angle and IOP fall
Hours later	10 patients developed angle closure and 20 patients develop narrow angle IOP in closed angle group: 10-27 mmHG and in narrow angle group: 20-29	Among 14 patients of open angle with high IOP, 5 developed angle closures.	Among 6 patients of open angle with high IOP, 1 patients developed angle closure.
p-value of IOP		Immediate = <0.005	Immediate = <0.013
		1 hour later = <0.005	1 hour later = <0.002
		2 hours later=<0.005	2 hours later=<0.002
		3 hours later=>0.01	3 hours later=>0.002

CONCLUSION

It is clearly evident from this study that after extensive laser photocoagulation in diabetic retinopathy patients, elevation in IOP may appear immediately or 1-2 hours or 1-2 days later and this last for 2-3 days. In most cases anterior chamber angle are open initially but in few cases, angle closure adds to outflow obstruction.

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