

# Immediate effects of panretinal photocoagulation laser on intraocular pressure in proliferative diabetic retinopathy

Mehmona Asgher<sup>1</sup>, Abdul Hannan<sup>2</sup>, Ume Sughra<sup>3</sup>, Saif Ullah<sup>4</sup>

<sup>1</sup> Pakistan Institute of Ophthalmology, Al-Shifa Trust Eye Hospital, Rawalpindi, Pakistan  
Head: prof. dr Wajid Ali Khan

<sup>2</sup> Retina Department, Al-Shifa Trust Eye Hospital, Rawalpindi, Pakistan  
Head: prof. dr Nadeem Qureshi

<sup>3</sup> Research Department, Al-Shifa Trust Eye Hospital, Rawalpindi, Pakistan  
Head: prof. dr Ume Sughra

<sup>4</sup> Optometry Department, Pakistan Institute of Ophthalmology, Al-Shifa Trust Eye Hospital, Rawalpindi, Pakistan  
Head: assistant prof. dr Saif Ullah



## HIGHLIGHTS

The main idea was to find out the Immediate effects of panretinal photocoagulation (PRP) laser on intraocular pressure in proliferative diabetic retinopathy and to check its association with age group, power group and number of shots group of PRP laser.

## ABSTRACT

**Introduction:** Diabetic retinopathy (DR), a major cause of global blindness, affecting approximately 93 million people worldwide. Its advanced stage, proliferative diabetic retinopathy (PDR), involves abnormal blood vessel growth, treated with PRP laser and anti-VEGF therapy. PRP uses Nd:YAG lasers to target retinal areas treatment.

**Objectives:** To find out the Immediate effects of panretinal photocoagulation (PRP) laser on intraocular pressure (IOP) in PDR and to check its association with age group, power group and number of shots group of PRP laser.

**Materials and methods:** A quasi-experimental pre and post-interventional study was carried out in Vitreo-retina Department of Tertiary Eye Care Hospital, from September 2020 to March 2021. A consecutive sampling technique was used. IOP was measured just before and after 20 min of laser with Goldmann applanation tonometer (GAT). Along with IOP, power, pulses/shots and spot size applied during PRP laser were also noted in the self-structured proforma. Data was analyzed using SPSS.

**Results:** Out of total 90 subjects, the rise in IOP was observed in 54 (60%) subjects while IOP was decreased in 27 (30%) and in 9 (10%) subjects there were no changes noted in IOP after PRP laser. Paired t-test results showed that IOP before (16.10 [±4.11] mmHg) and IOP after (17.90 [±5.23] mmHg) had statistically significant differences  $t(89) = 4.179$ ;  $p = 0.001$ . Independent samples t-test results showed that IOP differences had significant association with number of shots group of PRP laser  $p = 0.02$ , while it showed non-significant association with age group  $p = 0.09$  and power group of PRP laser  $p = 0.97$  respectively.

**Conclusion:** Acute elevation in IOP was observed after PRP laser, number of shots applied during PRP laser had significant association with differences in IOP.

**Key words:** proliferative diabetic retinopathy, panretinal photocoagulation, intraocular pressure

## INTRODUCTION

Diabetic retinopathy (DR) is also known as 'diabetic eye disease' which is mainly caused by long duration systemic diabetes or uncontrolled blood sugar level. It is a non-inflammatory disease of the retina, characterized by progressive damage to retinal vasculature due to chronic hyperglycemia [1, 2]. DR is one of the most important cause of visual loss worldwide [3]. Globally, 95 million (35.4%) people approximately suffering from DR, of which  $\frac{1}{3}$  have vision threatening DR [4, 5] and it is the 5<sup>th</sup> most common cause of blindness worldwide [6]. In Pakistan the prevalence of DR is 28.78% with a variation of 10.6% to 91.3% [7] but once it occurs it cause irreversible blindness. According to a recent analysis, 93 million people were suffering from DR worldwide, of which 17 million were suffering from proliferative diabetic retinopathy (PDR) while 28 million were sufferers of vision threatening DR [8].

PDR is the advance stage of DR [9] in which small leaky new vessels starts growing on the retina, known as NVDs (new vessels at disc) and NVEs (new vessels elsewhere) on retina [10]. Panretinal photocoagulation (PRP) laser along with intravitreal anti-VEGF (vascular endothelial growth factor) is the main treatment of choice in PDR [11, 12]. In PRP laser, frequency-doubled Nd:YAG (neodymium-doped yttrium aluminium garnet) laser of 532 nm wavelength is used. The treatment usually consist of approximately 1500–5000 burns spot size varies from patient to patient depends on severity of disease [13].

Many factors are responsible for affecting intraocular pressure (IOP) due to PRP. IOP is the aqueous fluid pressure inside the eye [14]. The equal amount of production and drainage of aqueous humor keeps the IOP at normal range from 10 mmHg to 21 mmHg, the mean value is 16 mmHg [15].

In Pakistan Rajar et al. [16], Ali et al. [17], Ahmad et al. [18], had done some work on significance of PRP in PDR, such as comparison between PRP laser alone and PRP laser along with intravitreal bevacizumab (IVB) in treatment of PDR done by different people in Pakistan, in which they concluded that IVB in short term is effective as auxiliary treatment to PRP laser with initial and higher rate of retinal new vessels regression than PRP laser alone in PDR [16–18] but specifically no work done on effects of doubled frequency Nd:YAG laser PRP on IOP in PDR. Blondeau et al. [19], observed the acute pressure elevation following extensive argon laser PRP. Some evidences proved instantaneous pressure elevation that may be as high as 900 mmHg and last for only 2 ms but with either xenon laser or ruby laser PRP [20].

So our target was to evaluate the immediate effects of doubled frequency Nd:YAG laser PRP [21] on IOP and to find out its association with number of shots/pulses and power of PRP laser.

## OBJECTIVES

To find out the immediate effects of PRP laser on IOP in PDR. To check its association with age group, power group and number of shots group of PRP laser.

## MATERIALS AND METHODS

A quasi-experimental pre- and post-interventional study was carried out to assess the immediate effects of PRP on IOP. Moreover, association between number of shots and power of PRP laser was also observed at Retina Department of a Tertiary Eye Care Hospital. This study occurred within duration of September 2020 to March 2021, the data was collected with consecutive sampling technique. The study was conducted after getting the approval from the Ethical Review Committee of Al-Shifa Research Centre. All the subjects diagnosed with DR who were prescribed first session PRP laser treatment in the laser clinic of Vitreo-retina Department, were included in this study.

The sample size was 90. Patients with PDR, with no previous history of glaucoma, with negative history of ocular hypertension, first session PRP laser with no ocular disease other than PDR and with no neurological damage to the disc were included in the study while those with neovascular glaucoma, pseudophakics, aphakic, with previous history of PRP laser, retinopathy other than DR and with history of any ocular surgical procedure were excluded in our study. Data was collected through a self-structured proforma, from subjects after dilating pupils with tropicamide 1%.

Fundoscopy with slit lamp biomicroscope in conjunction with 90 D or 66 D lens was done by an ophthalmologist. Only subjects with DR, who were prescribed with first session PRP laser, were considered in this study. The IOP was measured with Goldmann applanation tonometer (GAT) which was calibrated before use, with same slit lamp and same tonometer measured by same person before and after PRP laser, at same duration between 9:00 a.m. to 11:00 a.m. to avoid diurnal variations in IOP. The PRP laser was done by doubled frequency Nd:YAG vision laser multisport (V.10.13) by using Ocular's manster wide field or ultra-lens, few drops of hydroxypropyl methylcellulose were used to drop over the fundoscopic lens, spot size was 200  $\mu$ m.

Data was analyzed in SPSS version 26. The paired sample t-test was applied to check significant differences among IOP before and after PRP laser while the unpaired/independent t-test was used to check association of IOP differences with power and number of shots of PRP laser. The study was conducted after taking the approval of the ethical review board with ref. no. Opto\_IRB/10-05. Verbal informed consent was obtained from every single patient included in this study. Confidentiality of the data was ensured and used only for academic purposes. Study was carried out by following up tenet of Helsinki.

**RESULTS**

A total number of 90 subjects participated in this study included both genders male (N = 62; 68.9%) and female (N = 28; 31.1%). Out of 90 subjects, 45 (50%) received number of shots/pulses less than 1611.50 and 45 (50%) received number of shots greater than 1611.50. In power group 47 (52.2%) subjects were exposed to power of PRP laser greater than 740 mv and 43 (47.7%) were exposed to power less than 740 mv (fig. 1).

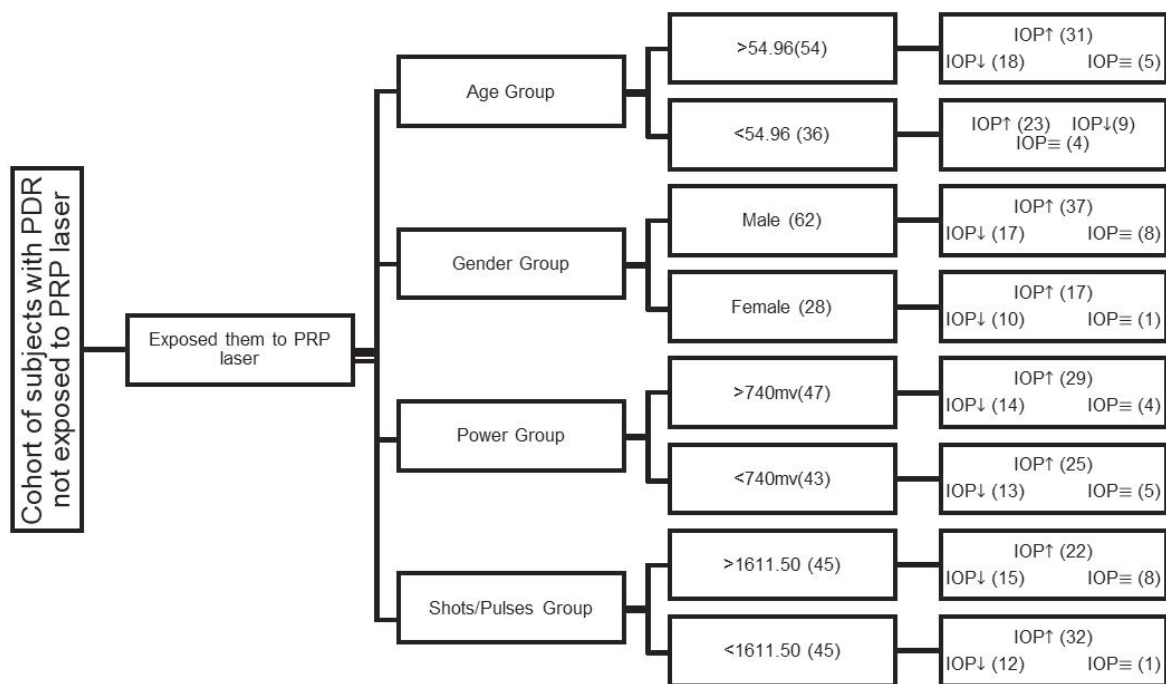
tion ( $r = 0.307$ ) and it was statistically significant  $p = 0.003$ . Coefficient of determination ( $r^2$ ) explained 9.4% variation in outcome variable (IOP differences) due to number of shots/pulses (tab. 2).

**DISCUSSION**

The main objective of the study was to check that does PRP laser immediately effects IOP. Moreover, the association

**FIGURE 1**

Flow chart of all independent variables outcome after PRP laser.



Paired t-test was run after checking assumptions of normality. Results showed that IOP before (16.10 [±4.11] mmHg) and IOP after (17.90 [±5.23] mmHg) had statistically significant differences  $t(89) = 4.179$ ;  $p = 0.001$ .

Independent samples t-test was run to check association of IOP differences with gender, age, power and shots group. The test was run after checking assumptions of normality and homogeneity of variance (Levene's test). Results showed that IOP differences had significant association with number of shots applied during PRP laser  $t(88) = 2.269$ ;  $p = 0.02$ . While no significant association was seen among IOP differences with power group ( $p = 0.97$ ), age group ( $p = 0.09$ ) and gender ( $p = 0.88$ ) (tab. 1).

Pearson correlation was conducted to check relation between IOP differences (1.80 [±4.0] mmHg) and number of shots/pulses applied during PRP laser (1843.9 [±895.6]). The test was run after checking assumptions of normality and linearity. The results showed a weak positive correla-

**TABLE 1**

Inferential statistics results.

Variables	N (%)	Mean (±SD)	t-test (d.f.)	p-value
<b>Gender</b>				
Male	62 (68.9%)		0.144 (88)	0.88
Female	28 (31.1%)			
<b>Age group</b>				
>54.96	54 (60%)		1.714 (88)	0.09
<54.96	36 (40%)			
<b>Power group</b>				
<740	43 (47.8%)		0.031 (88)	0.97
>740	47 (52.2%)			
<b>Shots group</b>				
>1500	45 (50%)		2.269 (88)	0.02
<1500	45 (50%)			
<b>IOP differences</b>				
Before		16.10 (±4.11) mmHg	4.179 (89)	0.001
After		17.90 (±5.23) mmHg		

d.f. – degrees of freedom; IOP – intraocular pressure; SD – standard deviation.

TABLE 2

Correlation matrix.		
Variables	IOP differences	Number of shots/pulses
<b>IOP differences</b>		
Pearson correlation	0.307	1
Sig.(2-tailed)	0.003*	
N	90	90
<b>Number of shots/pulses</b>		
Pearson correlation	1	0.307
Sig. (2-tailed)		0.003*
N	90	90

\* correlation is significant at 0.01 level (2-tailed).

among IOP differences with various variable groups such as age, gender, power of PRP laser and number of shots was also analyzed. In this study the total number of participants was 90 including both genders 68.9% male and 31.1% female. Only the subjects with DR who were advised first session PRP laser were included in this study. Any subject with previous history of surgery or laser was excluded from the study.

The PRP laser was done by doubled frequency Nd:YAG laser, the spot size was 200  $\mu\text{m}$ . The IOP was once measured just before PRP laser in eyes already dilated with tropicamide 1% and 20 min after PRP laser by the same person, with GAT. In few of the patients, IOP was measured 30 min and even 40 min after PRP laser to assess its long term effects, it was noted that with the passage of time, more rise in IOP was observed.

In this study the mean IOP of subjects before PRP laser was 16 mmHg while mean IOP after PRP laser was 17 mmHg. Out of total 90 participants the rise in IOP was observed in 54 (60%) subjects while in 27 (30%) the IOP was decreased and in 9 (10%) there was no change noted in IOP after PRP laser. In majority of the subjects IOP was raised up to 4 mmHg and its statistical significance was proved by paired sample test ( $p = 0.001$ ) as shown in table 1.

On the other hand, we also checked the associations among IOP differences and other independent variables such as age, gender, power and number of shots/pulses by unpaired/independent samples t-test but only number of shots/pulses showed statistically significant association with IOP differences. While no association was shown among rest of the variables age ( $p = 0.09$ ), with gender ( $p = 0.88$ ), with power ( $p = 0.97$ ) with IOP differences. Pearson correlation was run to check relationship among number of shots/pulses and IOP differences, the results showed a weak positive correlation ( $r = 0.307$ ) and it was statistically significant  $p = 0.003$ . Coefficient of determination was also checked which explained 9.4% variation among independent and outcome variable.

In comparison to the one of the previous study done by Blondeau et al. [19], in which they observed acute rise in

IOP after PRP laser but the PRP was done by argon laser in their study, while in this study PRP with doubled frequency Nd:YAG laser was used.

Moreover, in that study spot size was 500  $\mu\text{m}$ , while it was 200  $\mu\text{m}$  in our study. On the other hand, subjects were also anesthetized by retrobulbar anesthesia in their study, while in our study only local anesthesia was given to patient in form of proparacaine hydrochloride 0.5% twice with the gap of 10 min before PRP laser. The duration of exposure in their study was 0.1 s to 0.2 s in majority, while in our study it was 0.5 s. Blondeau et al. [19], also monitored the state of anterior chamber angle but in our study it was predecided not to include subjects with any type of glaucoma to make sure the avoidance of confounding factor. Meanwhile, in both studies acute elevation of IOP after PRP laser was observed which persisted for several hours.

On the other side Schiødt et al. [22, 23], represented the evidence of small decrease in IOP but within the long period of 6 months after argon laser or xenon arc PRP laser in small sample, comparatively the small duration of about 20 min after PRP laser on same day was considered in this study. Moreover, PRP laser used was doubled frequency Nd:YAG laser not argon or xenon laser. We could not assess the IOP for long duration because of time limitation and on the other side the main objective of this study was to check transient effects of IOP just 20 min after PRP laser.

Kaufman et al. [24] in their study noted decrease in IOP following PRP laser but within 5 years of follow up [25–27], which is quite a long duration as compared to our study. They concluded that as PRP laser prevents NVGs (neovascular glaucoma) to an extent so the IOP will be decreased, but in our study we were not assessing the effects of PRP laser on prevention of NVGs rather we excluded all patients with NVGs to clearly check the effects of PRP laser in eyes with PDR. Moreover, they used both argon laser PRP with 500  $\mu\text{m}$  spot size and 800 to 1600 burns and xenon arc PRP laser of spot size 4.5° and 200–400 burns to treat PDR. While, we used Nd:YAG laser PRP with 300–3500 burns of spot size 200  $\mu\text{m}$ .

Limitations of the study were the time duration which was short, the effect of PRP laser should also be assessed for long duration. We could not measure the central corneal thickness as well, which should be measured to find out the exact IOP after applying central corneal thickness correction factor. Moreover, we only considered the patients with DR in our study not any other vascular disease like vein occlusion and artery occlusion or any other ischemic eye disease in which doubled frequency Nd:YAG laser PRP is advised to check the effects of PRP laser on IOP. The other major limitation was gonioscopy which should be done to rule out the narrow angle.

## CONCLUSION

The conclusion is that acute elevation in IOP was observed after PRP laser in PDR. The weak direct relationship among IOP differences and number of shots/pulses applied for PRP laser was also observed.

### CORRESPONDENCE

**Mehmona Asgher, MPH**

Pakistan Institute of Ophthalmology, Al-Shifa Trust Eye Hospital  
Rawalpindi 46000  
e-mail: memonaasgher@gmail.com

### ORCID

Mehmona Asgher – ID – <http://orcid.org/0000-0003-1265-1137>  
Abdul Hannan – ID – <http://orcid.org/0000-0003-3127-8315>  
Ume Sughra – ID – <http://orcid.org/0000-0002-1460-6260>  
Saif Ullah – ID – <http://orcid.org/0000-0003-3254-5585>

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**Authors' contributions:**

Concept and design: Mehmona Asgher.

Data collection: Abdul Hannan, Mehmona Asgher.

Drafting: Mehmona Asgher, Ume Sughra.

Statistical expertise: Mehmona Asgher.

Critical analysis: Saif Ullah.

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None.

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**Ethics:**

The content presented in the article complies with the principles of the Helsinki Declaration, EU directives and harmonized requirements for biomedical journals.