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Research Article

Effect of Panretinal Photocoagulation on Visual Field and Macular Function in Diabetic Retinopathy

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Abstract: A prospective interventional study was conducted among 40 eyes of 28 patients after taking informed consent. After proper history, examination and investigations PRP was performed . After completion of PRP patients were followed up at 1 week, 1 month and 3 months to access Best corrected visual acuity , Color vision , Contrast sensitivity , Visual field assessment and Indirect ophthalmoscopy . Out of 28 patients with very severe NPDR or PDR included in study , 19 patients were male and 9 female . After 3 months post PRP 82.50% had no loss in visual acquity (VA) , while 12.50% had 1 line loss and 5.00% had significant loss in VA by 2 or more than 2 lines . 82.50% of eyes regained their pre PRP contrast sensitivity while only (37.50%) regained their pretreatment color vision. PRP leads to stable field defect in central 30 degree of visual field. Mean difference of Mean deviation and Pattern standard deviation , before and after treatment was found to be highly significant statistically in all eyes undergoing study . Our study conclude that panretinal photocoagulation leads to decreased visual acquity and contrast senstivity in few patients , loss of colour vision in most of the patients and stable field defects in almost all the patients but for eyes with sight-threatening forms of diabetic retinopathy with good visual acuity PRP is effective in preventing blinding eye disease and ensure better quality of life.
Keywords: ophthalmoscopy, photocoagulation, color vision, Diabetic retinopathy.

INTRODUCTION

Diabetic retinopathy is one of the most prevalent cause of legal blindness amongst individuals of working age (20-65 years) . Patients with type I DM have higher risk of severe ocular complications however more cases are of type II DM therefore it accounts for a higher proportion of patients with visual impairment. A number of risk factors have been identified including hypertension, poor glycaemic control and increasing duration of diabetes [1-5]. Targeting these modifiable risk factors aggressively and regular screening to allow timely intervention with panretinal photocoagulation reduce the progression to proliferative retinopathy and vision loss.

MATERIAL AND METHORD

A prospective interventional study was conducted on 40 eyes of 28 patients attending the tertiary eye care centre GSVM Medical College Kanpur , India . Our study followed principles in the Declaration of Helsinki. Particulars of the patient (name, age, sex) were noted and written consent was taken.

Presenting complaints were elicited . History regarding age, duration of diabetes, other medical and surgical disorder and their treatment was recorded. Systemic examinations, especially pulse and BP were recorded to rule out presence of systemic hypertension .

1. Blood sugar : Fasting and post parandial , HbA_{1C} monitoring , lipid profile and renal function test .
2. Visual acuity by Snellen's chart , Intraocular pressure by applanation tonometer , Color vision was recorded by Ishihara chart , Contrast sensitivity by Pelli - Robson contrast chart , Visual field assessment by Humphrey field analyzer II programme 30-2 SITA standard .
3. Fundus evaluation done by Direct ophthalmoscopy , Indirect ophthalmoscopy , +90D examination . Fundus photography and fluorescein angiography by Carl Zeiss, visucam fundus camera .

Inclusion Criteria

After all these testing eyes with very severe NPDR and PDR underwent laser PRP.

Exclusion criteria

1. Diabetic retinopathy with CSME or apparent macular thickening on +90D slit lamp biomicroscopy examination.
2. Uncontrolled systemic hypertension.
3. Visual acuity less than 6/24.
4. Patients with congenital or acquired color vision defect.
5. Patients with visual field defect owing to glaucoma or any other systemic disease.
6. Evidence of Ischemic maculopathy on FFA.
7. Opaque ocular media
8. History of intravitreal drug use in last 3 months.

Technique of Laser PRP

All the selected eyes underwent laser PRP in 3 settings with a time gap of 4 to 7 days between 2 sitting . PRP was done by slit lamp mounted double frequency Nd:Yag (532 nm) laser of carl zeiss . Energy used was between 200 mW to 300 mW. Spot size being 300 µm for a time period 0.10 to 0.15 sec . Two spots were kept one spot size apart. An average of 2400 to 3000 spots were given. Before each session of PRP, complete fundus evaluation was done by Indirect ophthalmoscopy to look for recent changes like preretinal haemorrhage, vitreous haemorrhage, retinal detachment etc.

Follow up visits.

After completion of PRP patients were followed up at 1 week, 1 month and 3 months. On each follow up patients were evaluated for Best corrected visual acuity , Color vision , Contrast sensitivity , Visual field assessment and Indirect ophthalmoscopy .

RESULTS

Prevalence of PDR or very severe NPDR is more in male (68.75%) than in female (31.25%) with a sex ratio of 2.2:1.

Most of the eyes 22/40 (55.00%) had BCVA between 6/6 to 6/12. Therefore the patients with PDR or very severe NPDR can have good visual acuity.

One week after PRP 23/40eyes(57.50%)retained their prelaser vision , 9/40 (22.50%) of eyes lost at least 1 line of VA, while 8/40 (20.00%) of eyes had significant loss of VA by ≥ 2 lines. At a follow up of 1 month 29/40 eyes (72.50%) showed no reduction in vision, while 8/40eyes (20.00%) had 1 line of DOV and 4 eyes (10.00%) had significant DOV by 2 or more than 2 lines . At 3rd month postlaser 33/40 eyes (82.50%) had no loss in VA , while 5 eyes (12.50%) had 1 line loss in VA and 2 eyes (5.00%) had significant loss in VA by 2 or more than 2 lines . VA is reduced immediately after PRP due to development of macular edema and as the edema subsides vision improves. However chronic macular edema lead to persistent decrease in VA.

One week post PRP 35/40 (87.50%) of eyes showed reduction in contrast sensitivity by at least 0.15 log unit on Pelli-Robson contrast chart. After a follow up of 3 months most of the patients 33/40 (82.50%) of eyes regained their pre PRP contrast sensitivity.

Color vision on Ishihara's vision chart reduced in 32/40 (80.00%) of eyes one week post PRP. At a follow up of 3 months most of eyes did not regain 15/40(37.50%) their pre PRP color vision . One week after laser PRP, MD further worsened from -8.46dB to -10.14dB and PSD worsened from 7.26 dB to 8.78 dB. On follow up period of 3 months field changes did not improve. So we conclude that PRP leads to depression in visual field which does not improve on follow up.

Table-1: Comparison Of Vision Pre And Post PRP

Visual acuity	No of eyes pre – PRP	No of eyes 3 months post-PRP
6/6 to 6/12	22(55.00%)	21(52.50%)
6/18 to 6/24	18(45.00%)	16(40.00%)
Less than 6/24	-	3(7.50%)

Table -2: One Week After PRP

No of lines of loss in VA	No of eyes	Percentage
No loss of VA	23	57.50 %
1 Line loss of VA	9	22.50 %
≥ 2 Line loss of VA	8	20.00 %

Table-3: One Month After PRP

No of lines of loss in VA	No of eyes	Percentage
No loss of VA	29	72.50 %
1 Line loss of VA	7	17.50 %
≥ 2 Line loss of VA	4	10.00 %

Table-4: Three Months After PRP

No of lines of loss of vision	No of eyes	Percentage
No loss of VA	33	82.50 %
1 line loss of VA	5	12.50 %
≥ 2 line loss of VA	2	5.00%

Table-5: Effect on Contrast Sensitivity

Reduction in contrast sensitivity	One week after PRP	One month after PRP	Three months after PRP
By 0.15 log unit	25 eyes (62.50%)	19 eyes (47.50%)	5 eyes (12.50%)
By ≥ 0.30 log unit	11 eyes (27.50%)	9 eyes (22.50%)	-
No reduction	4 eyes (10.00%)	12 eyes (30.00%)	35 eyes (87.50%)

Table-6: Effect On Color Vision

No of plates read incorrectly	One week after PRP	One month after PRP	Three months after PRP
>4 plates	19 eyes (47.50%)	17 eyes (42.50%)	8 eyes (20.00%)
1 to 4 plates	14 eyes (35.00%)	11 eyes (27.50%)	19 eyes (47.50%)
No reduction	7 eyes (17.50%)	12 eyes (30.00%)	13 eyes (32.50%)

Table-7: Effect on Visual Field

GLOBAL INDICES	BEFORE PRP	One week after PRP	One month after PRP	Three months after PRP
MD	-8.46 db	-10.14 dB	-10.14 dB	-10.12 dB
PSD	7.26 dB	8.78 dB	8.77 dB	8.74 dB

DISCUSSION

Diabetic retinopathy is a serious and vision threatening complication of diabetes. Various treatment modalities for diabetes exist like, tight glycemic control, control of blood pressure, HbA1c monitoring, regular follow up, intravitreal steroid and anti-VEGF factors etc. But laser photocoagulation remains the treatment of choice for PDR and vision threatening retinopathy.

Various mechanisms by which PRP helps in the management of DR include decreased production of vasoproliferative substance by converting hypoxic retina into anoxic retina , upregulation the anti-angiogenic factors from retinal pigment epithelium and by thinning the retina allow increased diffusion of oxygen from choroid.

In our study (Table II) eyes 22/40 eyes (55.00%) had VA between 6/6 to 6/12 while 18/22 (45.00%) of eyes have VA between 6/18 to 6/24. None of the eyes has VA less than 6/24 pre PRP. However 3months post PRP 3/40 (7.50%) of eyes have VA less than 6/24 and total 6/40 (15.00%) eyes have shown decrease in VA. Also 1week after PRP (table III) 8/40 eyes (20.00%) had significant loss of vision by ≥ 2 lines and 9/40 (22.50%) of eyes have loss of vision by at least 1 line . This is in accordance with the study of Mcdonald HR et al [6] who reported decease in VA by ≥2lines in 44/175 (25%) of eyes. The most common cause being post laser of macular edema.

A loss of vision 1 week post PRP occured in 17/40 (42.50%) eyes but visual acuity gradually improves and at a follow up of 3 months when only 7/40 (17.50%) of eyes had visual loss, with only 5/40 (12.50%) of eyes had loss of vision by 1 line and 2/40 (5.00%) had a significant loss of vision by ≥ 2 lines . This is suppoted by Diabetic Retinopathy Study Research Group; DRS [7] where 1 line of loss of vision was found in 11% of eyes and 2 lines loss of vision in 3% of eyes.

None of eyes develop cataract, tractional retinal detachment, foveal exudation or vitreous haemorrhage during this follow up period. So, we observe that development of macular edema was the most common cause of loss in VA after PRP. Macular edema gradually improved leading to improvement in VA but some of the eyes develop persistent macular edema and thus pre-PRP, VA is not achieved .

1 week post PRP 25/40 (62.50%) of eyes showed reduction in contrast sensitivity by at least 0.15 log unit on Pelli-Robson contrast chart, but at a follow up of 3 months 35/40 (87.50%) that is most of eyes regain their pre- PRP contrast sensitivity. Khosla et al [8] studied contrast sensitivity of 18 eyes after Argon laser PRP using Cambridge low-contrast chart. Mean contrast sensitivity threshold increased significantly in the week(s) following PRP but returned to baseline by 3 months. Canning et al [9] compared the effect of argon blue-green and dye yellow laser on contrast sensitivity. They concluded that there was no difference and contrast sensitivity was decreased in both the groups. However the result of study by Rema et al [10] is not in concordance to our study where they found the most common cause of visual impairment post being vitreous haemorrhage in 31.7% , progression of cataract in 30%, chronic macular oedema in 23.8%, pre-retinal haemorrhage in the macula in 6 (9.5%) and pre-retinal fibrosis in 4.7% subjects . However this could be explained by the fact that these patients had a very poor pre PRP vision < 6/60 which may be because of severe diabetic eye disease leading to catastrophic complications .

In our study One week post PRP 33/40 (81.82%) of eyes showed reduction in color vision and at a follow up of 3 months 27/40 (63.64%) of eyes showed reduction in color vision. This is contrary to the result of study by Canning et al [9] and Khosla et al [8] to assess the effect of three different colors of laser by using Farsworth-Munsell 100 hue test. Their studies concluded that all examined eyes were tritanopic following PRP and did not recover to Pre-PRP level during the follow up period of 12 and 3months respectively . This is contrary to our study where 32.50% of eyes had color vision same as pre laser value this could be explained as in our study we used Ishihara's color testing chart which is less sensitive for detecting minor color vision error. Moreover Ishihara's chart detect red-green color defect and laser PRP mainly cause tritanopic color defect. This is why other studies detect more error in color vision which did not improve on a follow up.

Result of our study is supported by study Fong DS, did a retrospective questionnaire for assessing color vision before and after PRP. They reported that 31% out of 35 patients reported difficulty in sorting dark color before PRP but after treatment 69% had this difficulty [17].

In our study we assessed visual field by automated perimetry HFA II programme 30-2 SITA standard. Mean of MD was -8.46 dB and mean PSD was 7.26 therefore MD & PSD of visual field was diminished before laser PRP also. Our finding is supported by the study of Trick GL et al [11] who reported that, diabetics have significantly less peripheral visual field than their age matched normals. This decreased field in diabetics is due to sub clinical microangiopathy ca MD worsened from -8.46 dB to -10.14 dB, 1 week after PRP which does not improve at a follow up of 3 months (-10.12 dB). Likewise PSD also worsened from 7.26 dB before PRP to 8.78 dB 1 week after PRP and did not improve after a follow up of 3 months (8.74 dB).

Paired t-test was applied for MD & PSD before PRP and 3 months after PRP. T-test value is 6.135** for MD and 4.637** for PSD at a confidence limit (cl) of 95% (** $p < 0.001$). So the difference of MD & PSD before and after PRP was found to be highly significant statistically. Using ischemia and adversely affecting retinal function. Our finding is supported by the study of Pahor D [12] who did visual field comparison by using MD & CPSD before and after PRP. On the contrary to our study Khosla PK et al [13] reported that central retinal sensitivity significantly improved in all eyes in their study . But the findings of many other studies like Buckley **S** et al [14], Seiberth V et al [15] and Henricsson M et al [16] support the observation of our study.

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