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Original Research Article

Comparative Clinical Outcomes of Anti-VEGF Therapy Versus Panretinal Photocoagulation in Proliferative Diabetic Retinopathy: A Retrospective Study

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Abstract:

Background: Proliferative diabetic retinopathy (PDR) remains a major cause of vision loss globally. Anti-vascular endothelial growth factor (anti-VEGF) therapy and panretinal photocoagulation (PRP) are the two standard modalities, yet comparative real-world outcomes remain variably reported.

Objective: To compare visual, anatomical, and complication-related outcomes between anti- VEGF therapy and PRP in patients with PDR in a retrospective cohort.

Methods: A retrospective observational study included 60 eyes of 60 patients with PDR treated either with anti-VEGF monotherapy (n=30) or PRP (n=30). Baseline characteristics, best- corrected visual acuity (BCVA), optical coherence tomography (OCT) parameters, vitreous hemorrhage, neovascular regression, and need for vitrectomy were compared.

Results: Anti-VEGF group showed significantly better mean BCVA improvement at 12 months (0.21 ±0.09 logMAR) compared to PRP (0.09 ±0.07 logMAR, $p<0.001$). Central macular thickness reduction was also better in the anti-VEGF group ($p<0.01$). PRP group had higher rates of vitreous hemorrhage (26.7% vs 10%) and higher requirement for vitrectomy. Neovascular regression was comparable in both groups.

Conclusion: Anti-VEGF therapy demonstrated superior visual recovery and macular outcomes compared to PRP, while PRP showed higher complication rates. Integration of patient systemic inflammatory markers such as hs-CRP and amino acid profiles from earlier diabetes-related studies[1,2] may help predict treatment responses.

Keywords: Proliferative Diabetic Retinopathy, Anti-VEGF Therapy, Pan-retinal Photocoagulation, Visual Outcomes and Neovascularization.

Introduction

Diabetic retinopathy (DR) is a microvascular complication of diabetes and a major cause of preventable blindness worldwide. Proliferative diabetic retinopathy (PDR), characterized by retinal neovascularization, carries a high risk of vitreous hemorrhage and tractional retinal detachment. With rising diabetes burden in India and globally, optimal management strategies are critical.

Panretinal photocoagulation (PRP) has been the standard treatment for several decades, reducing retinal ischemic drive and minimizing neovascularization. However, PRP may be associated with peripheral field loss, worsening of macular edema, and patient discomfort.

The discovery of vascular endothelial growth factor (VEGF) as a key mediator of retinal neovascularization has revolutionized management. Anti-VEGF therapies including ranibizumab, bevacizumab, and aflibercept have convincingly shown benefit in regression of neovascularization, reduction of macular edema, and improvement in vision.

Systemic inflammation plays a major role in the pathophysiology of DR. Markers such as hs- CRP, ferritin, and HbA1c were shown to correlate with worsening microvascular complications in earlier diabetes research, including the studies by SBJ et al. on hs-CRP, ferritin, and HbA1c [1] and amino acid abnormalities in type 2 diabetes [2]. These systemic biomarkers may influence severity and outcomes in PDR, highlighting the need for treatment modalities that also address inflammatory and metabolic derangements. This retrospective study compares the clinical outcomes of anti-VEGF therapy versus PRP in PDR, providing real-world insights that may supplement ongoing evidence.

Materials and Methods

Study Design: A retrospective observational study conducted at a tertiary eye care center between January 2021 and December 2023.

Study Population: Total 60 eyes of 60 patients with confirmed PDR.

Inclusion Criteria

- Age 30–75 years
- Diagnosis of PDR based on ETDRS criteria
- Received either anti-VEGF monotherapy or PRP
- Minimum 12-month follow-up

Exclusion Criteria

- Prior vitrectomy
- Combined treatment (PRP + anti-VEGF)
- Media opacities preventing imaging
- Other retinal diseases

Groups

- **Group A (Anti-VEGF):** 30 eyes received bevacizumab/ranibizumab/aflibercept injections (monthly × 3 then PRN)
- **Group B (PRP):** 30 eyes underwent standard PRP (1200–1600 burns over 2–3 sessions)

Outcome Measures

- Best corrected visual acuity (BCVA, logMAR)
- Central macular thickness (CMT) on OCT
- Regression of neovascularization
- Incidence of vitreous hemorrhage
- Need for pars plana vitrectomy
- Complications

Statistical Analysis: SPSS version 25.0; $p<0.05$ considered significant.

Results

Table 1: Baseline Characteristics of Study Groups

Parameter	Anti-VEGF (n=30)	PRP (n=30)	p value
Age (years)	58.3 ± 8.1	57.9 ± 7.6	0.82
Gender (M/F)	17/13	18/12	0.79
Duration of Diabetes (years)	11.2 ± 4.5	10.8 ± 4.1	0.68
Baseline HbA1c (%)	8.9 ± 1.2	9.1 ± 1.3	0.54
Baseline BCVA (logMAR)	0.68 ± 0.22	0.71 ± 0.19	0.62

Table 2: Visual Outcomes

Outcome	Anti-VEGF	PRP	p value
Baseline BCVA (logMAR)	0.68 ± 0.22	0.71 ± 0.19	0.62
BCVA at 12 months (logMAR)	0.47 ± 0.15	0.62 ± 0.18	<0.001*
Mean improvement	0.21 ± 0.09	0.09 ± 0.07	<0.001*

Table 3: Anatomical and OCT Outcomes

Parameter	Anti-VEGF	PRP	p value
Baseline CMT (µm)	420 ± 55	415 ± 52	0.72
12-month CMT (µm)	330 ± 48	375 ± 50	<0.01*
% Reduction	21.4%	9.6%	<0.01*

Table 4: Complications

Complication	Anti-VEGF	PRP	p value
Vitreous hemorrhage	3 (10%)	8 (26.7%)	0.04*
Tractional RD	1 (3.3%)	3 (10%)	0.30
Need for vitrectomy	2 (6.7%)	6 (20%)	0.11
Macular edema aggravation	2 (6.7%)	7 (23.3%)	0.07

Table 5: Neovascularization Regression

Parameter	Anti-VEGF	PRP	p value
Complete regression	20 (66.7%)	18 (60%)	0.59
Partial regression	8 (26.7%)	10 (33.3%)	0.57
No regression	2 (6.7%)	2 (6.7%)	1.00

Discussion

This study demonstrates that anti-VEGF therapy offers better visual improvement and greater reduction in central macular thickness compared to PRP in patients with PDR over a 12-month follow-up. These findings align with DRCR.net Protocol S and other landmark trials.

Visual Outcomes: Anti-VEGF group achieved significantly higher BCVA improvement, reflecting its direct action on VEGF-mediated neovascularization and edema. PRP, though effective, may worsen macular edema due to inflammatory response.

Inflammation and Systemic Factors: Systemic inflammation plays a significant role in DR pathogenesis. The previously published work by Sushma BJ et al. showed elevated hs-CRP, ferritin, and HbA1c levels in patients with type 2 diabetes and their association with microvascular complications [1]. Another study by the same author highlighted alterations in amino acid metabolism in diabetics [2]. These biomarkers influence endothelial dysfunction, oxidative stress, and microvascular changes, potentially modulating response to PDR treatments. Patients with higher inflammatory burden may respond better to anti-VEGF therapy due to its anti-permeability and anti-inflammatory effects.

Complication Profile: PRP group had higher incidence of vitreous hemorrhage and macular edema worsening, consistent with earlier literature. Anti-VEGF therapy, while effective, requires repeated injections and adherence.

Neovascular Regression: Both groups showed comparable regression, indicating PRP remains valuable, especially in resource-limited settings.

Strengths: Real-world retrospective cohort, Uniform follow-up period & Inclusion of systemic biochemical context from earlier diabetes research

Limitations: Retrospective design, small sample size & Anti-VEGF agents not standardized across all patients.

Conclusion: Anti-VEGF therapy provides superior visual and macular anatomical improvement compared to PRP in PDR, with lower complications. PRP remains effective but may be associated with higher adverse events. Integration of systemic biomarkers such as hs- CRP, ferritin, HbA1c, and amino acid profiles may further refine personalized treatment strategies for PDR.

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