

# Clinical Characteristics of Proliferative Diabetic Retinopathy and Outcome of Pars Plana Vitrectomy in Proliferative Diabetic Retinopathy

Raba Thapa,<sup>1</sup> Sanjita Sharma,<sup>1</sup> Eli Pradhan,<sup>1</sup> Sushma Duwal,<sup>1</sup> Govinda Paudyal<sup>1</sup>

<sup>1</sup>Vitreo-retina service, Tilganga Institute of Ophthalmology, Kathmandu, Nepal.

## ABSTRACT

**Background:** Proliferative diabetic retinopathy is a leading cause of blindness among people with diabetes. The study aimed to assess the clinical characteristics of proliferative diabetic retinopathy and outcome of pars plana vitrectomy in Proliferative diabetic retinopathy.

**Methods:** A prospective study was conducted from September 2019 to December 2021 among consecutive cases of proliferative diabetic retinopathy who underwent pars plana vitrectomy at a tertiary eye care center. Study was conducted after ethical approval from Institutional Review Committee. Detailed systemic and ocular history, visual acuity, ocular findings under mydriasis, surgical procedures, and outcome following pars plana vitrectomy were recorded. Cases were followed up regularly until one year after the pars plana vitrectomy.

**Results:** Total of 83 cases (89 eyes) of proliferative diabetic retinopathy were enrolled in the study. The mean age was 53 years  $\pm$  9.7 SD, ranging from 26 years to 72 years. Males comprised of 62.7% cases. Type two diabetes comprised of 94% of cases. Indications for pars plana vitrectomy were; mixed vitreous hemorrhage and tractional retinal detachment (38.2%), non-clearing vitreous hemorrhage (38.1%), and tractional retinal detachment only (24.7%). Pre-operative intra-vitreous anti-vascular endothelial growth factor was given in 78.65% eyes and pan retinal photocoagulation in 58.42% eyes. The anatomical success was achieved in 95.5% eyes, visual improvement in 68.54%, static in 14.6% and worsened in 16.86% of eyes. About 15.7% of eyes had some form of post-operative complications.

**Conclusions:** Vitreous hemorrhage with tractional retinal detachment, persistent vitreous hemorrhage and tractional retinal detachment involving macula were the common indication of pars plana vitrectomy among cases of Proliferative diabetic retinopathy. Anatomical success and visual acuity improvement can be achieved in majority of the eyes following PPV in Proliferative diabetic retinopathy.

**Keywords:** Anatomical outcome; pars plana vitrectomy; proliferative diabetic retinopathy; visual outcome.

## INTRODUCTION

Proliferative diabetic retinopathy (PDR) is the leading cause of blindness among the people with diabetes. PDR needs prompt treatment to save the useful vision.<sup>1</sup> Early and high risk cases of PDR can be managed with pan-retinal photocoagulation (PRP) where-as advanced cases need surgical management.<sup>2,3</sup>

Newer techniques like micro-incision vitrectomy surgery (MIVS) using smaller gauge (G) vitrectomy like 23 G, 25 G as compared to older 20 G vitrectomy and anti-

vascular endothelial growth factor (anti-VEGF) use has shown marked improvement in outcome of PDR.<sup>4-7</sup> Perioperative anti VEGF injections have shown benefit in reducing the intraoperative and post-operative retinal and vitreous hemorrhage.<sup>5</sup> Surgical treatment is the last treatment option for treating advanced PDR.<sup>8</sup> There are very limited studies in our part regarding the surgical outcome of PDR.

This study aimed to assess the clinical characteristics and outcome of PPV in PDR at a tertiary eye care center in Nepal.

**Correspondence:** Raba Thapa, Vitreo-retina service, Tilganga Institute of Ophthalmology, Kathmandu, Nepal. Email: rabathapa@live.com, Phone: +9779841406884.

## METHODS

This is a hospital based prospective study conducted at vitreo-retinal service of Tilganga Institute of Ophthalmology (TIO), a tertiary eye care center, in Nepal. All consecutive patients with PDR undergoing pars plana vitrectomy from September 2019 to December 2021 were enrolled in the study. The study duration was prolonged due to COVID 19 pandemics, affecting overall service utilization. The study was conducted after the ethical approval by Tilganga Institute of Ophthalmology-Institutional Review Committee (TIO- IRC) (15/2019), Kathmandu, Nepal. Written informed consent was taken from the study participants before enrollment in the study. Study was conducted as per the guidelines of Declaration of Helsinki.

Inclusion criteria: All consecutive patients of PDR treated with PPV with endo-laser with or without internal temponade were enrolled in the study. Exclusion criteria: Patients with PDR with prior history of endophthalmitis, concurrent retinal disease affecting visual acuity like age related macular degeneration, traumatic sequelae of posterior segment and those patients not willing to participate in the study were excluded from the study.

DR was graded using Early Treatment Diabetic Retinopathy (ETDRS) Criteria.<sup>1</sup> In brief, DR was classified as NPDR and PDR. PDR was further classified as early, high risk and advanced PDR.

Detailed history included demographic profile, chief complains, types and duration of diabetes, any other systemic problems like hypertension, hyperlipidaemia, cardiac diseases etc. Treatment history included information on prior laser therapy, use of anti VEGF and or other intra-vitreous injections, any other surgical procedures along with its duration.

Presenting and best corrected visual acuity were recorded. Detailed anterior and posterior segment evaluation was done using 90 Diopter (D), and 20 D lens. Preoperative intravitreal anti VEGF 3 to 5 days prior to PPV, intraoperative procedures, and any complications were noted if any.

Patients with fasting and postprandial blood sugar level (<180 mg/dl) were only underwent for surgery. Blood sugar were repeated within two to three days following surgery to maintain good glycaemic control. Those who need surgery in second eye, the gap was ranged from three weeks to six weeks from the first surgery.

Patients were followed up at day one, day seven, six weeks thereafter every three months until a year following the PPV. At each follow up, presenting and best corrected visual acuity, anterior and posterior segment findings, any complications and further surgical procedures were recorded.

The characteristics of PDR were categorized as vitreous hemorrhage, combined TRD with vitreous hemorrhage and only TRD. When the retina is flat, this has been termed as anatomical success after the surgery.

Standard proforma was used to record the details of history and examination findings.

Descriptive statistical measures such as mean  $\pm$  standard deviation (SD) for continuous variables and percentage for categorical variables were calculated. Association between two independent categorical variables were assessed by using Chi-square or Fisher's exact test wherever applicable. The result was considered significant if p-value <0.05 at 5% level of significance. Statistical analysis were performed using SPSS 19 version.

## RESULTS

A total of 89 eyes of 83 cases with PDR were enrolled in the study during the study period. Almost three fifth 52 (62.7%) of the cases were males. Among the study participants, type 2 diabetes comprised of 78 cases (94%) and rest 5 (6%) were type 1 diabetes.

The mean age of study participant was 53 years  $\pm$  9.7 SD, age ranged from 26 years to 72 years. Majority of the subjects 33 cases (39.8%) were at the age group 51 to 60 years. Two thirds of the cases (64.4%) were from out of the Kathmandu valley. Housewife/household works comprised of 24 cases (28.9%), followed by agriculture, 20 cases (24.1%). Table 1

**Table 1. Demographic characteristic of patients with PDR undergoing PPV.**

Age group	Frequency (n)	Percent (%)
Up to 30 years	1	1.2
31-40 years	9	10.8
41-50 years	23	27.7
51-60 years	33	39.8
61-70 years	14	16.9
71-80 years	3	3.6

**Table 1. Demographic characteristic of patients with PDR undergoing PPV.**

Age group	Frequency (n)	Percent (%)
Total	83	100
<b>Gender</b>		
Male	52	62.7
Female	31	37.3
Total	83	100
<b>Occupation</b>		
Agriculture	20	24.1
Business	11	13.3
Housewife/ household works	24	28.9
Service	9	10.8
Retired service	12	14.5
Others	7	8.4
Total	83	100.00

Fifty one cases (61.4%) had concurrent systemic hypertension. History of peripheral neuropathy was found in nearly one third of cases 25 cases (30.1%), followed by almost one fourth each of diabetic nephropathy 22 cases (26.5%), and diabetic foot in 21 cases (25.3%).

Almost four fifth of the operated eyes 70 (78.7%) had visual acuity of less than 3/60 before the PPV. Nine percent each had BCVA of 6/18 to 6/60 and 6/60 to 3/60. (Table 2)

**Table 2. Preoperative BCVA in operated eye for PDR.**

Pre-operative visual acuity (BCVA)	Number (n)	Percent (%)
<6/12 to 6/18	3	3.4
<6/18 to 6/60	8	9
<6/60 to 3/60	8	9
3/60 to PL	70	78.7
Total	89	100

The average duration of symptoms of blurring of vision was 3 months in our series. Among the total cases,

bilateral surgery was done in 12 cases and rest of the cases underwent PPV in single eye. Pre-operatively, intra-vitreous anti VEGF was given in 70 eyes (78.65%) and prior PRP was received in 52 eyes (58.42%).

Among the 89 eyes, indication for PPV was non-clearing vitreous hemorrhage (38.1%), combined vitreous hemorrhage and TRD (28.2%) and TRD only (24.7%). Intra-operatively, 60 eyes (67.4%) had silicone oil tamponade, 23 eyes (25.8%) had gas tamponade with perfluoropropane (C3F8)

and 6 eyes (6.8%) had air tamponade after PPV and endo-laser.

Overall, anatomical success was achieved in 95.5% of eyes. During the course of follow up, 4.5% of total eyes had retinal detachment. It was highest with pure TRD (9.1%). (Table 3)

**Table 3. Characteristics of PDR and anatomical success in eyes following PPV.**

Characteristics of PDR	Number of eyes (n/%)	Flat retina (n/%)	Detached retina (n/%)
Combined TRD and vitreous hemorrhage	34 (38.2)	33 (97.1)	1 (2.9)
Non-clearing vitreous hemorrhage	33(38.1)	32 (96.96)	1 (3.04)
TRD only threatening to macula	22 (24.7)	20 (90.9)	2 (9.1)
Total	89	85 (95.5)	4 (4.5)

Following surgery, the improvement of vision was found in 61 (68.54%), static in 13 (14.6%) and worse in 15 (16.86%). The visual acuity was no perception of light in 3 cases. Post -operatively, worsening of vision was found mainly in TRD and cases with poor pre-operative visual acuity.

Among the eyes with TRD, improvement in vision was found in 45% and stable in 10%.

The mean BCVA was 1.91 Log MAR pre-operatively. BCVA was improved after six weeks of PPV in majority of eyes. At 12 months follow up, the mean BCVA was 1.45 Log MAR. (Table 4)

**Table 4. Visual acuity in operated eyes following PPV.**

Visual Acuity duration	UCVA Log-MAR (mean)	BCVA Log-MAR (mean)
Pre-operative	1.93	1.91
Post-operative Day 1	2.14	2.13
Post-operative day 7	2.05	2.03
Post-operative 6 weeks	1.8	1.71
Post-operative 3 months	1.78	1.65
Post-operative 6 months	1.8	1.65
Post-operative 9 months	1.50	1.45
Post-operative 12 months	1.50	1.45

Among the total operative eyes, 15.73% of eyes had some form of complications. Neo-vascular glaucoma was found in highest 4 (4.49%), followed by exudates in AC 3 (3.37%), high intraocular pressure (IOP) in 2 (2.25%) and corneal abrasion 2 (2.25%). Table 5

**Table 5. Post-operative complications in eyes following PPV.**

Post-operative complications	Number (n)	Percent (%)
Corneal abrasion	2	2.25
High IOP	2	2.25
Hyphema	1	1.12
Retinal detachment	1	1.12
Choroidal detachment	1	1.12
Neo-vascular glaucoma	4	4.49
Exudates in AC	3	3.37
Total	14	15.73

## DISCUSSION

In our study, the mean age of patients undergoing vitrectomy for PDR was 53 years  $\pm$  9.7 SD. DR is the leading cause of legal blindness among the working age group in developed countries.<sup>9,10</sup>

The predominant working age people in our study showed that in low middle income countries like Nepal, those affected by visual impairment and blindness were also the working age group people. Three fifth (62.7%) of the study participants were males, consistent with the other study on demographic profile of patients with PDR in Nepal.<sup>11</sup> Almost two third of the people who underwent surgery for PDR were from out of capital city, reflecting the limited access to treatment in these areas. The majority of the patients in our series were housewife/household works (28.9%), followed by agriculture (24.1%) and business (13.3%). Despite of more physical activities, more cases from agriculture group could be due to delay in diagnosis and treatment.

The predominant type two diabetes (94%) in our series is consistent with the other studies.<sup>9-13</sup> One fourth of patients with PDR had other major systemic complications of diabetes such as neuropathy (30.1%), nephropathy (26.5%) and diabetic foot (25.3%). DR increases the risk of developing nephropathy and is also a strong predictor of stroke and cardiovascular disease. PDR is a strong risk factor for peripheral arterial disease, leading to diabetic foot.<sup>14</sup> The high prevalence of other systemic complications of diabetes in our series highlights the importance of collaborative approach in management.

Among the patients undergoing surgery, majority (38.2%) underwent vitrectomy for combined TRD with vitreous hemorrhage followed by non-clearing vitreous hemorrhage (38.1%), and TRD threatening to macula (24.7%).

Our study findings are consistent with this study by Choovuthayakorn et al.<sup>4</sup> where the main indication of PPV was tractional retinal detachment (36.6%), persistent vitreous hemorrhage (35.4%), and combined tractional and rhegmatogenous retinal detachment (14.5%). Our findings was also consistent with the series by Gupta et al.<sup>7</sup> which reported the reason for vitrectomy was TRD and persistent vitreous haemorrhage.

In our study, the overall anatomical success was achieved in 95.5% of eyes. During the course of follow up, 4.5% of total eyes had retinal detachment, highest with TRD (9.1%). Abunajma et al. reported the anatomic success in 90.6% of their case series with TRD.<sup>6</sup> Our findings on anatomic success was consistent with their series. Our findings were also consistent with the series by Gupta et al.<sup>8</sup> which reported anatomic success in 95.3% of eyes at final follow-up after PPV.

The improvement of vision following surgery was found in 68.54%, and static in 14.6% in our case series. However, among the eyes with TRD, improvement in vision was found in 45% and stable in 10%. Our findings on visual acuity improvement in TRD were consistent with the series by Choovuthayakorn et al where the improvement in visual acuity was achieved in nearly half of patients after PPV.<sup>4</sup> Post-operatively, worsening of vision was found mainly in TRD and cases with poor pre-operative visual acuity in our study. Our findings were similar to the study by Choovuthayakorn et al where poor final visual outcomes were related to the lower initial visual acuity levels besides the intraoperative retinal breaks, and postoperative retained silicone oil in their series.<sup>4</sup> Our findings were also consistent with Gupta et al<sup>7</sup> where 50% of the eyes with TRD and vitreous hemorrhage and 87% of the eyes with vitreous hemorrhage improved at least three ETDRS lines at 12 months.

In our series, nearly 15% of eyes had some form of complications. The lower rates of complications in our series could be due to many cases receiving perioperative intravitreal anti VEGF three to five days prior to PPV (78.65%) and laser therapy (58.42%). Our findings were consistent with the series by Gupta et al.<sup>4,7</sup> Choovuthayakorn et al also reported the decrease in risk for intraoperative retinal break development and incidence of early dense postoperative vitreous hemorrhage with the use of perioperative anti VEGF their series.<sup>4</sup>

## CONCLUSIONS

Combined vitreous hemorrhage with TRD, followed by vitreous hemorrhage and TRD involving macula are the common indications of PPV among patients with PDR. Anatomical success and visual acuity improvement can be achieved in majority of the eyes following PPV in PDR.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## REFERENCES

1. Early Treatment Diabetic Retinopathy Study Research Group: Early photocoagulation for diabetic retinopathy: ETDRS report 9. *Ophthalmology* 1981;98:766-785.doi; [https://doi.org/10.1016/S0161-6420\(13\)38011-7](https://doi.org/10.1016/S0161-6420(13)38011-7)
2. Diabetic Retinopathy Vitrectomy Study Research Group. Early vitrectomy for severe vitreous hemorrhage in diabetic retinopathy. Two-year results of a randomized trial. Diabetic Retinopathy Vitrectomy Study Report 2. *Arch Ophthalmol* 1985;103(11):1644-1652.doi; <https://doi.org/10.1001/archopht.1985.01050110038020>
3. Recchia FM, Scott IU, Brown GC, Brown MM, Ho AC, IP MS. Small gauze-gauze pars plana vitrectomy: a report by the American Academy of Ophthalmology. *Ophthalmology* 2010;117(9):1851-1857.doi; <https://doi.org/10.1016/j.ophtha.2010.06.014>
4. Choovuthayakorn J, Khunsongkiet P, Patikulsil D, Watanachai N, Kunavisarut P, Chaikitmongkol V, Ittipunkul N. Characteristics and Outcomes of Pars Plana Vitrectomy for Proliferative Diabetic Retinopathy Patients in a Limited Resource Tertiary Center over an Eight-Year Period. *Journal of Ophthalmology* 2019. doi; <https://doi.org/10.1155/2019/9481902>
5. Diabetic Retinopathy Vitrectomy Study Research Group. Early vitrectomy for severe proliferative diabetic retinopathy in eyes with useful vision. Results of a randomized trial. Diabetic Retinopathy Vitrectomy Study Report 3. *Ophthalmology* 1988;95(10):1307-1320.doi; [https://doi.org/10.1016/S0161-6420\(88\)33015-0](https://doi.org/10.1016/S0161-6420(88)33015-0)
6. Abunajma MA, Dhibi HA, Abboud EB, Zahrani YA, Alharthi E, Alkharashi A, Ghazi NG. The outcomes and prognostic factors of vitrectomy in chronic diabetic traction macular detachment. *Clinical Ophthalmol* 2016;10:doi; <https://doi.org/10.2147/OPHT.S98555>
7. Gupta B, Sivaprasad S, Wong R, Laidlaw A, Jackson TL, McHugh D, Williamson TH. Visual and anatomical outcomes following vitrectomy for complications of diabetic retinopathy: The DRIVE UK Study. *Eye* 2012;26:510-516.doi; <https://doi.org/10.1038/eye.2011.321>
8. Gupta B, Wong R, Sivaprasad S, Williamson TH. Surgical and visual outcome following 20-gauge vitrectomy in proliferative diabetic retinopathy over a 10-year period, evidence for change in practice. *Eye* 2012;26:576-582.doi; <https://doi.org/10.1038/eye.2011.348>
9. Ruta LM, Magliano DJ, Lemesurier R, Taylor HR, Zimmet PZ, Shaw JE. Prevalence of diabetic

- retinopathy in type 2 diabetes in developing and developed countries. *Diabet Med.* 2013;30:387-398.doi; <https://doi.org/10.1111/dme.12119>
10. Eye Diseases Prevalence Research Group. The prevalence of diabetic retinopathy among adults in the United States. *Arch Ophthalmol.* 2004; 122:552-563.doi; <https://doi.org/10.1001/archophth.122.4.552>
  11. Thapa R, Bajimaya S, Sharma S, Rai BB, Paudyal G. Systemic association of newly diagnosed proliferative diabetic retinopathy among type 2 diabetes patients presented at a tertiary eye hospital of Nepal. *Nepal J Ophthalmol* 2015;7(13):26-32. PMID: 26695602 doi; <https://doi.org/10.3126/nepjoph.v7i1.13163>
  12. Thapa R, Joshi DM, Rizyal A, Maharjan N, Joshi RD. Prevalence, risk factors and awareness of diabetic retinopathy among admitted diabetic patients at a tertiary level hospital in Kathmandu. *Nepal J Ophthalmol* 2014; 6(11):24-30. PMID: 25341843 doi; <https://doi.org/10.3126/nepjoph.v6i1.10760>
  13. Thapa R, Twyana S, Paudyal G, Khanal S, van Nispen R, Tan S, Thapa SS, van Rens GHMB. Prevalence and risk factors of diabetic retinopathy among an elderly population with diabetes in Nepal: The Bhaktapur Retina Study. *Clinical Ophthalmology* 2018, 12:561-568. PMID: 29615832doi; <https://doi.org/10.2147/OPTH.S157560>
  14. Pearce I, Simó R, Lövestam-Adrian M, Wong DT, Evans M. Association between diabetic eye disease and other complications of diabetes: implications for care. A systematic review. *Diabetes, obesity and metabolism.* 2019 Mar;21(3):467-78.doi; <https://doi.org/10.1111/dom.13550>