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ORIGINAL RESEARCH

Long-Standing Macula-Involving Diabetic Tractional Retinal Detachments with Good Visual Acuity: How Should We Manage These Patients?

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Purpose: We assess the merits of pars plana vitrectomy (PPV) in subjects with good visual acuity (VA) and a chronic macula-involving tractional retinal detachment (TRD) secondary to proliferative diabetic retinopathy (PDR).

Methods: A retrospective review of medical records was undertaken. Subjects were divided into 1) a Study Group of subjects who underwent prompt PPV and 2) a Control Group of subjects in which PPV was deferred in favor of less invasive treatment options or observations. Both study and control subjects had a baseline Snellen VA of ≥20/50 and a PDR-associated macula-involving TRD of >6 months duration with a minimum follow-up of 12-months.

Results: There were 58 patients analyzed over an average follow-up period of 27.6 (±7.1) months. The change in VA was similar in the Study Group compared to the Control Group (p=0.94) with both groups losing about three lines of VA during the study period (−0.30 ±0.52 logMAR). Although the rates of maintaining ≥20/200 Snellen VA and ≥20/50 Snellen VA were similar in the Study Group compared to the Control Group (p=0.55 and p=0.28, respectively), the Study Group had more subjects gaining ≥2 lines of VA during the study period (p=0.002).

Conclusion: Patients presenting with good VA and a PDR-associated macula-involving TRD of >6 months were more likely to gain ≥2 lines of VA when PPV was performed at baseline compared to PPV deferral until further deterioration occurred.

Keywords: chronic tractional retinal detachment, diabetic vitrectomy, good visual acuity

Introduction

Tractional retinal detachment (TRD) involving or threatening the center of the macula is one of the principal indications for pars plana vitrectomy (PPV) in proliferative diabetic retinopathy (PDR) patients manifesting advanced disease.[1,2] However, the most appropriate management strategy for a long-standing PDR-associated macula-involving TRD with good visual acuity is currently uncertain. Characteristically, the presenting visual acuity is poor in macula-involving TRD cases of >6 months duration.[3] McCullough et al[4] in their recent meta-analysis concluded that the reattachment rate in PDR-associated TRD cases after PPV was high, but that postoperative visual acuity (VA) was typically poor and patients with better preoperative VA manifested better postoperative VA regardless of TRD duration. Nevertheless, there exists a subgroup of PDR-associated TRD cases, which present with relatively good VA even though the center of the macula has been reportedly detached for a long period of time, and there is controversy regarding the advisability of PPV in these circumstances.[1,2,5] The behavior of an extramacular PDR-associated TRD has been published and corroborated,[1,2,6] but the natural history of a PDR-associated macula-involving TRD when PPV is deferred in favor of observation or less invasive treatment options such as panretinal photocoagulation (PRP) or anti-vascular endothelial growth factor (VEGF) therapy is presently lacking. In this retrospective case-controlled study, PPV at baseline is compared to PPV deferral in PDR patients with a long-standing macula-involving TRD and good visual acuity in order to gain lucidity regarding the virtues of each management strategy in this patient population.

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Methods

This research was undertaken as a retrospective, case-controlled study. It was compliant with the principles of the Declaration of Helsinki and the Health Insurance Portability and Accountability Act of 1996. Approval of the project was granted by the Panhandle Eye Group Institutional Review Board (IORG0009239; IRB00011013-17). Informed consent was waived by the Panhandle Eye Group Institutional Review Board because the information was collected retrospectively and all identifying subject data was removed. The records review was taken from subjects who received treatment and follow-up care from July 2015 through May 2023 at a private practice institution in Amarillo, TX, and a university-associated teaching facility in Nuevo Leon, Mexico.

Table 1 exhibits the criteria for inclusion and exclusion employed during the study. A coexisting vitreous hemorrhage (VH) is permissible so long as the TRD meets the inclusion/exclusion criteria. Only one eye per study subject was analyzed. If the criteria for inclusion and exclusion were met by both eyes, a simulated coin-toss program decided which eye would be analyzed. If subjects were found to have >36 months of follow-up after the baseline examination, then the subject's "final" follow-up collection of data was concluded at 36 months (± 12 weeks).

Patients that underwent PPV were allocated to the "Study Group", while patients in which PPV was deferred were allocated to the "Control Group." The "baseline" evaluation in this study was the examination in which the decision to perform PPV was made as was relevant to the Study Group or the decision to defer PPV was made as was relevant to the Control Group. A macula-involving TRD was diagnosed by the observation of preretinal fibrovascular tissues exerting ample traction to result in subretinal edema in the center of the macula on optical coherence tomography (OCT) (Heidelberg Spectralis, Heidelberg, Germany). The maximum height of the subretinal fluid in the center of the macula was measured using the "Overlay" measuring feature of the Heidelberg Spectralis software. The study defined neovascular glaucoma (NVG) as rubeosis with an intraocular pressure of ≥30 mm Hg in the affected eye. For the purpose of the study, subjects in the Control Group who lost ≥3 lines of Snellen VA during the study period with no other clinical explanation apart from the effects of a chronic macula-involving TRD were considered to have had "progression of the TRD".

Subjects in the Study Group were administered a preoperative intravitreal anti-VEGF injection 1–14 days prior to the surgery. Small-gauge (23- or 25-gauge) PPV by 6 fellowship-trained retina surgeons under peribulbar or retrobulbar anesthesia was undertaken utilizing the Constellation Vision System (Alcon, TX, USA) platform. High-speed cutting rates (10–20 thousand cuts/minute) were applied. Fibrovascular tissue extraction, endolaser photocoagulation placement, and endodiathermy utilization were conducted according to the unique situation of each subject. Careful and methodical preretinal fibrous tissue removal was undertaken until all exerting traction was eliminated. Hemostasis was obtained by meticulous endodiathermy applications to all relevant areas and by surgeon-induced intraocular pressure increases. Endodiathermy drainage retinotomies were made at the judgment of the operating surgeon. Endolaser photocoagulation was administered until all four quadrants of the retina had laser spots at least to the vitreous base. Dye-assisted membrane

Table 1 Long-Standing Diabetic Tractional Retinal Detachment Management. Criteria for Inclusion and Exclusion

Inclusion	Exclusion
The subject had Type I or II diabetes mellitus	The subject had less than 12 months (52 weeks) of follow-up after the baseline evaluation
The Snellen best-corrected visual acuity in the study eye was ≥ 20/50	The subject had undergone a PPV for any indication prior to baseline
A center of the macula-involving tractional retinal detachment secondary to complications of proliferative diabetic retinopathy was present in the study eye	The subject had an underlying condition, which in the opinion of the evaluating specialist, could be responsible for ≥ 2 lines of Snellen acuity despite the presence of the macula-involving tractional retinal detachment (ie significant cataract, VH, advanced glaucoma, etc.)
The study eye had a subjective history of unchanged vision loss of 6 months (26 weeks) or more at baseline	A concomitant rhegmatogenous retinal detachment was evident

Abbreviations: PPV, pars plana vitrectomy; VH, vitreous hemorrhage.

peeling and internal limiting peeling were conducted according to the inclination of the surgeon and according to patient need. The choice of a vitreous substitute was determined according to the surgeon's judgment. Postoperative positioning was advised according to the unique situation of each patient and according to the operating surgeon's judgment.

Subjects in the Control Group were managed in an office-based setting with one or more anti-VEGF injections, one or more sessions of PRP, a combination of anti-VEGF therapy and PRP, or observation alone whenever appropriate PRP had previously been performed prior to baseline. All postoperative interventions and complications were recorded for both cohorts. Adverse events explicitly evaluated for during the study period were development of NVG, recurrence of retinal detachment (relevant to the Study Group), progression of the TRD (relevant to the Control Group), and development of VH. A persistent VH after PPV was defined as a VH documented from postoperative day 1 until beyond 90 postoperative days, while a de novo VH after PPV was defined as a VH happening after a documented period of clear media.

Same-session cataract surgery in the Study Group was considered in subjects who lacked financial resources and/or access to future care (because of substantial traveling distance). Cataract surgery was performed in the postoperative period in the Study Group or during the study period in the Control Group if, in the opinion of the examiner, development or progression of a cataract was deemed to be responsible for >2 lines of visual acuity loss.

Primary and Secondary Outcomes

Change in visual acuity during the study period was the primary outcome. Secondary outcomes included the rate of subjects achieving ≥20/50 Snellen VA, the rate of subjects achieving ≥20/200 Snellen VA, and the rate of subjects gaining ≥2 lines of VA during the study period.

Statistical Analysis

The JMP 11 (SAS Institute, USA) statistical software package was utilized. Nominal outcome variables were assessed via contingency analysis with likelihood ratios, whereas one-way analysis of the variance assessed numerical outcomes. Visual acuity measurements are denoted in logMAR units with parenthetical Snellen complements. The following logMAR values were used for low visual acuities: "Counting Fingers" = 2.0, "Hand Motions at 1–3 feet" = 2.3, "Light Perception" = 2.6, and "No Light Perception" = 3.0.

Results

The study analyzed a total of 58 patients (27 in the Study Group and 31 in the Control Group). Table 2 exhibits the baseline characteristics of both cohorts. The only statistically significant difference in baseline characteristics observed among cohorts was the baseline VA, which was 0.05 logMAR different in favor of the Control Group. For the Study Group, reasons listed in the medical record for undergoing PPV were as follows: 1) 44.4% (12/27) were in the opinion of the evaluating surgeon "high-risk" for progression without intervention, 2) 37.0% (10/27) were in the opinion of the evaluating surgeon at risk for long-term photoreceptor atrophy if PPV was not performed, 3) 7.4% (2/27) of subjects had no reason listed, 4) 7.4% (2/27) of cases were performed at the request of the patient because of the patient's fear of blindness without surgery, and 5) 3.7% (1/27) of cases were performed at the request of the patient because the patient's belief that the condition would improve after PPV. For the Control Group, reasons listed in the medical record for deferring PPV were as follows: 1) 45.2% (10/31) of subjects were in the opinion of the evaluating surgeon too "high-risk" for ending up with worse vision if PPV was performed, 2) the TRD and vision in 25.8% (8/31) of subjects was in the opinion of the evaluating surgeon likely to remain stable for the foreseeable future without surgery, 3) 12.9% (4/31) of subjects could not be offered surgery for lack of funding, 4) 9.7% (3/31) of subjects were in the opinion of the evaluating surgeon good candidates for anti-VEGF therapy alone, 5) 6.5% (2/31) of subjects declined PPV because they did not perceive any visual disturbance at the time, 6) 6.5% (2/31) of subjects declined PPV because they believed PPV would result in worsening vision, 7) 3.2% (1/31) of subjects declined PPV because they preferred less invasive treatment options first, and 8) 3.2% (1/31) of subjects had no reason listed.

Table 2 Long-Standing Diabetic Tractional Retinal Detachment Management. Baseline Characteristics of the Cohorts. Means with (95% Confidence Intervals)

Characteristic	Study Group (PPV) N=27	Control Group (Deferred PV) N=31	p-value
Age (years)	55.5 (51.5–59.4) Range = 38–81	58.0 (54.3–61.7) Range = 35–85	0.36
Gender	Male = 12 (44.4%) Female = 15 (55.6%)	Male = 14 (45.2%) Female = 17 (54.8%)	0.96
Diabetes Mellitus Type	Type 1 = 3 (11.1%) Type 2 = 24 (88.9%)	Type 1 = 2 (6.4%) Type 2 = 29 (93.6%)	0.53
Visual Acuity (logMAR)	0.37 (0.34–0.40) Range = 0.3–0.4	0.32 (0.29–0.34) Range = 0.1–0.4	0.004
Duration of Vision Loss (months)	9.1 (7.4–10.8) Range = 6–24	10.0 (8.4–11.6) Range = 6–24	0.42
History of prior PRP ± anti-VEGF injections	Yes = 17 (63.0%) No = 10 (37.0%)	Yes = 13 (41.9%) No = 18 (58.1%)	0.11
Hemoglobin A1C (%)	9.4 (8.4–10.3) Range = 6–15	10.0 (9.1–10.9) Range = 6–16	0.37
Lens Status	Pseudophakia = 3 (11.1%) Phakic = 24 (88.9%)	Pseudophakia = 3 (9.7%) Phakic = 28 (90.3%)	0.86
Presence of concomitant vitreous hemorrhage	Yes = 9 (33.3%) No = 18 (66.7%)	Yes = 12 (38.7%) No = 19 (61.3%)	0.82
Maximum Subfoveal Subretinal Fluid Height (microns)	271 (205–337)	293 (226–360)	0.74

Abbreviations: PRP, panretinal photocoagulation; TRD, tractional retinal detachment; PPV, pars plana vitrectomy; VEGF, vascular endothelial growth factor.

Study Group Perioperative Details

The average time for the preoperatively administered anti-VEGF injection was 5.7 (±2.3) days prior to PPV (Range=2–10). The average operating time to perform the PPV was 34.7 (±13.3) minutes (Range=20–75). Internal limiting peeling was conducted in 63.0% (17/29) of cases, and subtenons triamcinolone administration was done at the end of PPV in 59.3% (16/29) of cases. The following vitreous substitutes were used: silicone oil = 3 (11.1%), gas = 14 (51.9%), air = 10 (37.0%), and balanced salt solution = 0. Intraoperative complications occurred as follows: None = 63.0% (17/29) of cases, posterior iatrogenic retinal hole(s) = 7.4% (2/29) of cases, peripheral iatrogenic retinal hole(s) = 14.8% (4/29) of cases, inability to achieve hemostasis = 7.4% (2/29) of cases, inability to fully reattach the retina = 0, and combination = 7.4% (2/29) of cases. There were 40.7% (11/27) of subjects in the Study Group, who underwent same-session phacoemulsification with intraocular lens implantation immediately prior to PPV. No intraoperative complications occurred during any of the cataract surgeries.

Outcomes

The Study Group's overall visual acuity changed from 0.37 logMAR (0.21–0.53) (Snellen 20/47) to 0.66 (0.50–0.82) logMAR (Snellen 20/91) for a loss of 0.29 (p=0.013). The Control Group's overall visual acuity changed from 0.32 logMAR (0.19–0.44) (Snellen 20/42) to 0.62 logMAR (0.49–0.74) (Snellen 20/83) for a loss of 0.30 (p=0.001). The change in VA was not significant between cohorts (p=0.94). The Study Group had 40.7% (11/27) of subjects who achieved ≥20/50 Snellen VA, while the Control Group had 54.8% (17/31) of subjects who achieved ≥20/50 Snellen VA (p=0.28). The Study Group had 85.2% (23/27) of subjects who achieved ≥20/200 Snellen VA, while the Control Group had 90.3% (28/31) of subjects who achieved ≥20/200 Snellen VA (p=0.55). The Study Group had 74.1% (20/27) of subjects who ended up within 3 lines of VA from baseline, while the Control Group had 77.4% (24/31) of subjects who

ended up within 3 lines of VA from baseline (p=0.77). The Study Group had 22.2% (6/27) of subjects who ended up gaining ≥2 lines of VA from baseline, while the Control Group had 0% who ended up gaining ≥2 lines of VA from baseline (p=0.002). There were no subjects in either cohort who developed "No Light Perception" during the study period.

Table 3 exhibits other study outcomes. The single surgery reattachment rate was 88.9% (24/27) in the Study Group. The Study Group had the following post-surgical complications related to PDR: none = 63.0% (17/27), recurrent retinal detachment = 11.1% (3/27), de novo VH = 11.1% (3/27), persistent VH = 11.1% (3/27), NVG = 3.7% (1/27). Out of the four subjects who underwent a secondary PPV during the study period (two for recurrent detachment and two for VH) in the Study Group, all four ended up with worse than three lines of VA at the study's end. Patients who developed NVG were managed with topical therapy and did not require filtration surgery. There were two subjects (7.4%) in the Study Group, who received a YAG capsulotomy during the study period. There were five subjects in the Study Group, who underwent uneventful cataract surgery during the postoperative study period.

The Control Group had the following complications related to PDR during the study period: none = 67.7% (21/31), progression of the TRD = 22.6% (7/31), new-onset VH = 6.5% (2/31) and NVG = 3.2% (1/31). One patient who developed NVG was successfully managed with topical therapy and did not undergo filtration surgery. Out of the seven subjects in the Control Group who had a progression of the TRD, five received both PRP and anti-VEGF therapy, while two received PRP alone (no anti-VEGF therapy) during the study period. Out of the seven subjects in the Control Group who underwent PPV during the study period, five were for the indication of progression of TRD, while two were for the indication of new-onset VH. The time until PPV was 10.4 (8.2–12.6) months from baseline, and all 7 subjects had >12

Table 3 Long-Standing Diabetic Tractional Retinal Detachment Management. Study Outcomes. Means with (95% Confidence Intervals)

Characteristic	Study Group (PPV) N=27	Control Group (Deferred PPV) N=31	p-value
Total Follow-up (months)	28.7 (25.9–31.4) Range = 15–38	26.7 (24.2–29.3) Range = 12–37	0.30
Final Visual Acuity (logMAR)	0.66 (0.46–0.87) Range = 0–2.3	0.62 (0.43–0.81) Range = 0.2–2.3	0.75
IOP > 30 mm Hg during the study period	Yes = 2 (7.4%) No = 25 (92.6%)	Yes = 3 (9.7%) No = 28 (90.3%)	0.76
Development of NVG	Yes = 1 (3.7%) No = 26 (96.3%)	Yes = 1 (3.2%) No = 30 (96.8%)	0.92
Performance of one or more NON-operating room treatments for PDR during the study period Type of Treatment	Yes = 6 (22.2%) No = 21 (77.8%) Anti-VEGF injections = 6[##] PRP = 0 Both PRP and anti-VEGF therapy = 0	Yes = 28 (90.3%) No = 3 (9.7%) Anti-VEGF injections= 4** PRP = 8 Both PRP and anti-VEGF therapy = 16	<0.0001
Performance of one or more PPVs during the study period (NOT counting the initial PPV in the Study Group) secondary to PDR complications	Yes = 4 (14.8%) No = 23 (85.2%)	Yes = 7 (22.6%) No = 24 (77.4%)	0.45
Other Complications Type of Complication	Yes = 9 (33.3%) No = 18 (66.7%) Recurrent RD = 3 VH = 6	Yes = 9 (29.0%) No = 22 (71.0%) Progression of TRD = 7 VH = 2	0.72

Notes: [##]All 6 injections in the Study Group were 1.25 mg Bevacizumab. **All 20 injections in the Control Group were 1.25 mg Bevacizumab.
Abbreviations: PDR, proliferative diabetic retinopathy; PRP, panretinal photocoagulation; TRD, tractional retinal detachment; PPV, pars plana vitrectomy; VEGF, vascular endothelial growth factor; IOP, intraocular pressure; RD, retinal detachment; NVG, neovascular glaucoma; VH, vitreous hemorrhage.

months of post-PPV follow-up. Out of the five subjects who underwent PPV for the indication of TRD progression, an 80% (4/5) single surgery success rate was observed, but the Snellen VA ended up with worse than 3 lines in all 5 subjects from their baseline value at the end of the study. There were 19.3% (6/31) of subjects in the Control Group who were observed to have macular reattachment (no subretinal fluid on OCT) at the end of the study period without undergoing PPV; 4 of these subjects maintained ≥20/50 Snellen acuity at the end of the study period. All patients observed to have macular reattachment at the end of the study period without undergoing PPV in the Control Group received one or more anti-VEGF treatments and PRP.

Cataract surgery was performed on 84.6% (11/13) of phakic subjects during the postoperative period in the Study Group and 32.1% (9/28) of phakic subjects in the Control Group during the study period because of cataract progression. All seven subjects in the Control Group who underwent PPV during the study period also received cataract surgery during the study period. Of the three subjects in the Study Group and the two subjects in the Control Group who underwent silicone oil tamponade during their primary PPV, two subjects in the Study Group and one subject in the Control Group underwent silicone oil removal during the study interval. None of these subjects experienced recurrence of retinal detachment following silicone oil removal.

Subgroup analysis was conducted with regard to the TRD duration. There were no significant findings that correlated with final Snellen VA, likelihood of achieving ≥20/200 Snellen VA, or the likelihood of achieving ≥20/200 Snellen VA for either cohort ($p>0.05$ for all).

Discussion

In general, a long-standing PDR-associated TRD involving the center of the macula presents to the retina specialist with poor VA and carries a poor prognosis for VA recovery even when successful anatomical reattachment is achieved.[1–4] However, on occasion, subjects in this same patient population present with Snellen VA that is quite good (≥20/50). Historically, researchers have suggested observation alone for any and all long-standing PDR-associated macula-involving TRDs because of the presumed poor VA prognosis.[7,8] Nevertheless, with the advent of improved surgical techniques, instrumentation, PPV platforms, surgical adjuvants, illumination, and viewing systems, others have reported meaningful improvements in VA in this subgroup previously deemed inoperable.[9–12] Abunajma et al[12] reported stable or improved VA in ≥90% of cases after PPV in their retrospective study of PDR-associated macula-involving TRDs of at least 6 months; however, on review of their included subjects, none had preoperative Snellen VA ≥ 20/50. Upon a literature review, the authors were unable to identify any published reports regarding the natural history of PDR-associated macula-involving TRDs when observed with good presenting VA (≥20/50). Therefore, how best to manage these challenging patients is a controversy, relies on "expert opinion", and requires a cautious and unique approach to the risks and benefits of PPV or its deferral on a patient-by-patient basis. Our case-controlled study provides an evaluation of these patients both from a natural history perspective (Control Group) and from a postsurgical perspective (Study Group).

The VA deteriorated approximately 3 lines of logMAR VA in both cohorts during the approximate 2-year study period. The incidence of achieving ≥20/50 Snellen VA and ≥20/200 Snellen VA was also not statistically significant between cohorts. This information should be useful to retina specialists when counseling patients prior to PPV scheduling and when formulating a management strategy for subjects in the population evaluated in this study. The single surgery reattachment rate of 88.9% in the Study Group was broadly on par with the single surgery reattachment rate reported in other studies evaluating chronic PDR-associated macula-involving TRDs.[4,12] Although the number of subjects was small in the Control Group who had PPV deferred during the study period until TRD progression occurred, the single surgery reattachment rate of 80% appears similar to the rate in the Study Group; however, all of these subjects in the Control Group ended up with worse than 3 Snellen lines of VA from baseline VA. It is alarming to the authors that none of the subjects who had deferral of PPV until the TRD progressed in the Control Group was able to recover VA within three Snellen lines from baseline, whereas about 60% of subjects ended up with VA within 3 Snellen lines from baseline when PPV was performed shortly after presentation as in the Study Group. Therefore, if the management strategy of PPV deferral until TRD progression (as defined by a drop in VA of three or more Snellen lines) occurs in this patient population, then the specialist should be aware that a poor VA outcome will likely be the result.

The natural history of an extrafoveal PDR-associated TRD has been evaluated,[1,2,6] but very little is known regarding the natural history of a macula-involving PDR-associated TRD when surgical intervention is deferred, especially when good VA is initially present. An abstract by Lin et al[13] reported that 36% of subjects (a total of 74 eyes) with a macula-involving PDR-associated TRD recovered ≥2 lines of Snellen VA after 1 year of observation alone. They did not report how many subjects in their study initially had ≥20/50 Snellen VA. However, there were no patients in our study's Control Group who gained ≥2 lines of Snellen VA during the study period, although about 22% of patients gained ≥2 lines of Snellen VA during the study period in the Study Group. This is a notable benefit for patients who underwent PPV shortly after presentation compared to patients who had PPV deferral until further complications occurred in our study. A retrospective study by Cohen et al[14] reported that 37.5% (51/136) of subjects remained with stable or improved VA after more than 4 years of follow-up with observations alone. If we consider ≥20/50 Snellen VA at the end of our study period as "stable or improved", then the 55% and 41% of subjects in the Control and Study Groups, respectively, who maintained this level of VA are broadly on par with the study by Cohen et al.[14] The study by Cohen et al[14] also noted that "spontaneous reattachment" occurred in 19.9% (27/136) of subjects managed by observation alone, and other authors have reported this as well when observation alone was the management strategy.[15] There were just three subjects in the Control Group of our study who were managed by observation alone, and none of these subjects experienced "spontaneous reattachment." However, about 20% of the subjects in the Control Group experienced macular reattachment by the end of the study period following anti-VEGF treatment ± PRP but without undergoing PPV. Reattachment without PPV in macula-involving PDR-associated TRDs has been reported by other authors after anti-VEGF treatment and has been called the "favorable crunch", although the incidence of this occurrence is unknown and has been sparsely reported-on.[16]

Although the "favorable crunch" was observed in our study in approximately 20% of cases in the Control Group after administration of anti-VEGF with or without PRP, care must be taken when administering anti-VEGF to an eye with a PDR-associated TRD because rapid neovascular regression may cause further traction on the friable retina.[17] Rates of TRD progression or development have been reported to occur in 3–5% of cases after anti-VEGF injections in PDR subjects;[18] however, none of these subjects already had a macula-involving TRD. Out of the seven subjects in the Control Group who were considered to have TRD progression (as evidenced by a drop in vision by three or more lines of VA) during the study period, five received anti-VEGF injections and PRP, whereas two received PRP without any injections. We are unable to conclude whether or not the anti-VEGF injections (or PRP) provoked this worsening or if it was just the natural history of the TRD without surgical intervention by PPV. A much larger number of subjects managed by observation alone in this patient population would be needed to determine the incidence of "TRD progression" without anti-VEGF therapy or PRP than the paltry three subjects reported-on in this study.

This study's strengths are its case-controlled design, its comparatively large number of cases included given the scarcity of reports published on subjects with long-standing PDR-associated macula-involving TRDs and good baseline VA, and its long follow-up period. Weaknesses of our study consist of its retrospective design, its reliance on subjective patient history when determining the presumed duration of the macula-involving TRD, its use of Snellen visual acuity with pinhole approximation (rather than ETDRS letter scoring with manifest refraction), and its inclusion of cases from a developing country that were mostly indigent. Patients living in a developed nation such as the United States may have better access to medical services and diabetic care, and this conceivably could result in better outcomes. Our study population's blood glucose levels were uncontrolled as evidenced by the very high hemoglobin A1c levels measured upon presentation; a population with better control of blood glucose may feasibly have better outcomes as well. The authors would like to see future research conducted in subjects with similar inclusion/exclusion criteria as those in our study in order to validate our analysis. In conclusion, the average patient with a good baseline VA and a macula-involving PDR-associated TRD of >6 months duration lost about three lines of Snellen VA after approximately 2 years of follow-up regardless of whether or not PPV was performed shortly after presentation or deferred until further deterioration was observed. However, a significant minority of patients who underwent PPV shortly after presentation gained ≥2 lines of Snellen VA, whereas no subjects experienced a gain of ≥2 lines of Snellen VA when PPV was deferred. When

PPV was deferred until further VA worsening occurred, no subjects recovered within three Snellen lines of VA from their baseline value even when PPV was later performed, whereas about 60% of subjects stayed within 3 Snellen lines of VA from their baseline value when PPV was performed shortly after baseline. However, about 20% of cases may undergo a "favorable crunch" and resolution of the detachment with anti-VEGF treatment ± PRP without a PPV. These findings may have important implications when counseling these patients regarding potential management strategies upon presentation, and this study provides data and analysis to help guide specialists in decision-making in this challenging patient group.

Abbreviations

OCT, optical coherence tomography; TRD, tractional retinal detachment; PDR, proliferative diabetic retinopathy; PPV, pars plana vitrectomy; VA, visual acuity; VEGF, vascular endothelial growth factor.

Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics

The study was approved by the Panhandle Eye Group Institutional Review Board (IORG0009239; IRB00011013-17) in accordance with the Ethical Standards laid down in the Declaration of Helsinki.

Author Contributions

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval for the version to be published; and agree to be accountable for all aspects of the work.

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Disclosure

None are relevant to this study; the authors have no financial, proprietary, or other competing interests to disclose.

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