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The Rate of Neovascular Glaucoma following Pars Plana Vitrectomy for Diabetic Tractional Retinal Detachment

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Abstract

Purpose: To evaluate the rate and possible risk factors of the development of neovascular glaucoma (NVG) in eyes with pars plana vitrectomy (PPV) for diabetic tractional retinal detachment (TRD).

Methods: A retrospective review of 65 eyes from 55 patients who had PPV for diabetic TRD from 2007 to 2014 at the Retina Consultants of Alabama and University of Alabama School of Medicine. Exclusion criteria included history of glaucoma, iris neovascularization, previous vitrectomy, ocular hypertension, and other causes of NVG, such as vein occlusion and ocular ischemia syndrome.

Results: The average age of patients studied was 49.8 years, and more than 70% of the eyes studied were affected by diabetes mellitus type 2. 1 (1.5%) of the 65 eyes developed NVG after PPV for diabetic TRD at 6 months, and 7 (10.8%) developed ocular neovascularization (ONV). None of the factors studied showed statistically significant differences between eyes that did not develop ONV to the eyes that did develop ONV. Overall, average best-corrected visual acuity (BCVA) improved from a logMAR of about 1 to 0.8 at 6 months, regardless of ONV. Our one eye with NVG had minimal BCVA improvement at 6 months.

Conclusion: With no known risk factors, NVG is a very rare complication in eyes with PPV for diabetic TRD within the first six postoperative months, and BCVA improvement is possible for these eyes.

Keywords: Proliferative diabetic retinopathy; Tractional retinal detachment; Vitrectomy; Diabetic retinopathy; Neovascular glaucoma

Introduction

Tractional retinal detachments (TRD), a complication of proliferative diabetic retinopathy (PDR), form when fibrovascular membranes (FVM) create traction on the underlying retina. Pars plana vitrectomy (PPV) is used to effectively treat many complications from PDR, including TRDs [1-4]. Qamar et al. [2] concluded that TRDs secondary to PDR can be treated successfully by PPV, especially TRDs without a retinal break. 65 of 84 eyes (75%) in their study had an improvement in best corrected visual acuity (BCVA). 20, 23, and 25-guage PPVs have all had comparable outcomes when used for diabetic TRDs [3,4]. However, PPVs come with complications, one of which includes neovascular glaucoma (NVG). Gupta et al. [5,6] reported that 2 (0.6%) of 346 PDR eyes treated with PPV developed NVG; another study found a higher NVG rate of 10.0%. Goto et al. [7] showed that 7.1% of their PDR eyes developed NVG following PPV and also concluded that preoperative TRD was not a risk factor for developing NVG. However, none of these studies comments on the rate of NVG for specifically TRDs because they included eyes with vitreous hemorrhages, macular edema, and other PDR complications without TRDs, and only a few studies have studied this specific topic. Ozone et al. [4] had one similar study in 2001 and reported that 1 of the 36 (2.8%) TRD eyes, which were treated with 25-gauge PPV, developed postoperative NVG. Recently, Rahimy et al. [8] conducted a study at a county hospital and found a much higher NVG rate of 8% in patients with diabetic TRD treated with a fellow-performed vitrectomy. A new 2015 study of 24 eyes showed a 0% NVG rate postoperatively in these patients [9].

In this study, we further analyze the rate and characteristics of NVG in eyes with 25-gauge PPVs for diabetic TRDs. In addition, we studied the rates of other postoperative complications following 25-gauge vitrectomy.

Methods

The Institutional Review Board of the University of Alabama at Birmingham School of Medicine approved our study. We retrospectively analyzed the charts of 55 patients, who underwent 25-gauge PPV for diabetic TRD with PDR from October 2007 to February 2014 at the Retina Consultants of Alabama (Birmingham, AL). The inclusion criteria included follow-up for at least six months and a previous diagnosis of PDR and TRD in the study eye. All diagnoses of diabetic TRD were made by one of the four practicing retinal specialist. Eyes with previous PPVs, rhegmatogenous retinal detachment component, proliferative vitreoretinopathy, ocular neovascularization, glaucoma, ocular hypertension, or other likely causes of neovascularization were excluded. Other likely causes of neovascularization included vein occlusions, ocular ischemia syndrome, radiation retinopathy, and uveitis. The main primary outcome included the postoperative rate of NVG follow vitrectomy. NVG was defined as the presence of iris neovascularization (NVI) with an intraocular pressure (IOP) greater than 22 mmHg without prior history of glaucoma or ocular hypertension [10].

Additional measures included other characteristics of eyes that developed postoperative NVG. These characteristics included age, gender, preoperative and postoperative IOP, peak IOP, BCVA (at preoperative, 3 months, and 6 months), timing of NVG development, management of

NVG, and other ocular conditions. Additionally, others postoperative complications were studied, including the rates of vitreous hemorrhage, retinal ischemia, and epimacular proliferation (EMP). For visual acuities, logMAR values were calculated from Snellen values, and values for counting fingers, hand motion, and light perception were given logMAR values of 1.98, 2.23, and 2.3, respectively [11].

Statistically analysis and calculations were conducted using Microsoft Excel 2011. p values were calculated using the Microsoft Excel *via* Fisher's test two tailed method. A p-value of less that 0.05 is considered statistically significant.

Results

A total of 55 patient charts (65 eyes) were included in our study (Table 1). 30 patients were female, and 25 patients were male. The average age of patients was 49.8 years. Most eyes (>70%) were affected by diabetes mellitus type 2 (versus type 1), and greater than 75% of the eyes in the study belong to patients on an insulin regimen. Table 1 lists other baseline characteristic, and also shows that there were no statistically significant differences in these baseline characteristics between the group that developed ONV and the group that didn't develop ONV. A recorded preoperative IOP was not found for all patients.

1 (1.5%) of the 65 eyes developed postoperative NVG (Table 2). In addition, 5 (7.7%) eyes developed neovascularization elsewhere, and 1 (1.5%) eye developed NVI. A total of 7 (10.8%) eyes had ocular neovascularization (ONV). More than 23% of eyes developed postoperative vitreous hemorrhage, followed by retinal ischemia which developed in about 10% of eyes. NVG, NVI, and EMP each developed in one eye. 3 eyes that developed ONV, including the one eye that developed NVG, also developed vitreous hemorrhage, but no other complications. 8 of the 58 eyes with no ONV had a cataract extraction with intraocular lens (CEIOL) placement during the same time. A total of 10 eyes in the study had CEIOL placement.

The one eye that developed NVG had a poor preoperative BCVA of light perception with a postoperative improvement to hand motion. PPV was performed when the patient was 60 years of age, and the patient had type 2 diabetes. In addition to PPV, CEIOL was performed at the same time. IOP was normal for both pre and post operation. The timing of NVG development was 6 months, with a peak pressure of 54 mmHg. Treatment included laser photocoagulation and anterior chamber tap with resolution of NVG.

In our study, there was an overall improvement in the average visual when comparing preoperative values to follow up values (Table 3). In eyes without NVG, BCVA improved from above 1 to about 0.8 at 6 month follow up, regardless of ONV. In the one eye with NVG development, visual improvement was minimal.

Discussion

The rate of NVG (1.5%) is our study is comparable and within range of the previously reported rate of NVG in eyes with PPV for PDR in general (regardless of specific indication) found in previously mentioned studies [5-7]. When specifically compared to TRD eyes only, our rate is similar to the 2.8% rate reported in Ozone et al. study and 0% rate found in Sternfeld's study, but significantly lower than the 8% rate reported by Rahimy et al. [4,8]. However, it should be mentioned that Rahimy et al.'s study was based on a county health system population, and the repairs were performed by fellows. Both of these add variability in terms of patients and the experience of the surgeon. It should also be noted that our study is the only one to mention eliminating eyes with a more like etiology of NVG, such as vein occlusions or ocular ischemia syndrome, thereby allowing us to assume that all of the NVG complications in our study were solely due to PDR.

Goto's [7] study found some independently associated risks, such as male gender, younger age, higher baseline IOP, and presence of NVG in the fellow eye; however, the presence of TRD was not found to be associated with the development of NVG. Of these factors, only one, higher baseline IOP (19 mm Hg) was prevalent in our one eye. It was

	No ONV	ONV	NVG	All Eyes	Percentage	P value
Number of patients	49	6	1	55	---	----
Male gender	22	3	0	25	0.45	
Number of eyes	58	7	1	65	---	----
Age of eyes (years)	49.9+/- 12.7	48.9+/- 13.1	60.1+/-0	49.8+/-12.6	---	0.85
Right eye	29	4	1	33	0.51	1
Diabetes type 1	17	3	0	20	0.31	0.67
Diabetes type 2	41	4	1	45	0.69	----
On insulin	44	5	1	49	0.75	1
TRD Macula	35	1	0	36	0.55	0.24
TRD Periphery	51	6	1	57	0.88	----
Preoperative VH	45	5	1	50	0.77	0.66
Macular edema	32	3	1	35	0.54	0.69
EMP	32	4	0	36	0.55	1
Silicone oil	11	1	0	12	0.18	1
Gas/Air	8	2	0	10	0.15	0.29
RRD	4	1	0	5	0.08	0.45
Preoperative IOP						
<10	1	0	0	1	0.02	1
10 to 22	26	7	1	33	0.51	1
>22	2	0	0	2	0.03	1

Table 1: Baseline characteristics of Eyes undergoing Pars Plana Vitrectomy for diabetic Tractional Retinal Detachment
Abbreviations: TRD: Tractional Retinal Detachment; VH: Vitreous Hemorrhage; EMP: Epimacular Proliferation; RRD: Rhegmatogenous Retinal Detachment; IOP: Intraocular Pressure
*A recorded preoperative IOP was only found for 36 eyes of the total 65 eyes.

Postoperative Complication	Number of Eyes (n=65)	Percent of Eyes (%)
Vitreous Hemorrhage	15	23.1
Ocular Neovascularization	7	10.8
Neovascularization Elsewhere	5	7.7
Neovascular Glaucoma	1	1.5
Iris Neovascularization	1	1.5
Retinal Ischemia	6	9.2
Epimacular Proliferation	1	1.5

Table 2: Complications following 25-Gauge Pars Plana Vitrectomy for Diabetic Tractional Retinal Detachment

Visual Acuity	No ONV	ONV	NVG
Number of eyes	58	7	1
Preoperative	1.05+/-.75	1.08+/-1.0	2.3
Number of eyes	43	7	1
3 Months	0.84+/-0.72	0.82+/-0.75	2.23
Number of eyes	26	6	0
6 Months	0.82+/-0.75	0.80+/-0.82	---

Table 3: Best corrected visual acuity at Preoperative, 3 months, and 6 months. **Abbreviations:** ONV: Ocular Neovascularization; NVG: Neovascular Glaucoma

difficult to find associated risk factors or correlations in our study since NVG developed only in one eye. In addition, we found no statistically significant differences between eyes that developed no ONV to the eye that developed ONV. Our study eye developed NVG at 6 months, which according to Goto's, is when about 60% of eyes with PPV for PDR develop NVG [7].

In Ozone's [4] study, all 4 eyes with postoperative NVG after vitrectomy for PDR had worse VA than preoperative BCVA. Three of these four eyes had a final BCVA of no light perception, and one of these eyes had PPV for TRD specifically. In contrast, our one eye had minimal improvement in BCVA from light perception to hand motion.

We recognize the limitations of this study including its retrospective nature, and that the follow-up period varied considerably between patients, even though we had a minimum of 6 months. Due to its retrospective nature, many patient charts were excluded from our study because of incomplete data, and certain data, such as visual acuities for 1, 3, and 6-month follow up, was not available for all patients in the study. We recommend further studies, likely prospective, that have longer follow up times, regularly scheduled follow up visits, and other possible risk factors, such as hemoglobin A1c. In addition, we would recommend eliminating eyes with more likely etiologies of NVG development. Nevertheless, we feel that our study has a very large number of patients with sufficient follow-up and data to make valid conclusions.

Conclusion

In conclusion, the rate of NVG following vitrectomy for diabetic TRD (with no other likely etiology of NVG) is rare and seems less likely than vitrectomies for other diabetic complications (vitreous hemorrhage, etc). In addition, there were no pre or post-operative variables that seemed to correlate with neovascularization, a risk for NVG development. Overall vitrectomies for diabetic TRD improved visual acuity in the vast majority of patients, and improved in the one eye with NVG. Even though NVG may not be as prevalent as other post-vitrectomy complications, these patients should be monitored for at least the six months after vitrectomy.

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Conflict of Interest

All of the authors have no proprietary interest.

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