Graefe's Archive for Clinical and Experimental Ophthalmology (2022) 260:791–798
https://doi.org/10.1007/s00417-021-05437-0

RETINAL DISORDERS

Association of staffing with Incidence of delayed retinal break or detachment after posterior vitreous detachment in a resident urgent care clinic

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Received: 22 June 2021 / Revised: 26 August 2021 / Accepted: 30 September 2021 / Published online: 18 October 2021

Abstract

Purpose To compare the incidence rate of delayed retinal break or detachment after diagnosis of acute, symptomatic posterior vitreous detachment (PVD) in a resident-run urgent care clinic (UCC) when staffed by a retina attending, non-retina ophthalmology attending, optometrist, or ophthalmology resident only.

Methods Retrospective consecutive case series. Of the 594 patients with acute, symptomatic PVD evaluated in the UCC at Penn State Eye Center between 1/1/2016 and 10/10/2019, 454 were included in the study; 140 were excluded because they were diagnosed with a retinal break or detachment on presentation to the UCC, had media opacity precluding examination, or had no follow-up within one year. Demographics, presenting examination findings, and type of staffing were recorded; subsequent visits up to 1 year were analyzed for presence of delayed retinal break or detachment.

Results Among 491 eyes of 454 patients with a mean follow-up of 147 days, ten delayed breaks (10/491, 2.0%) and three delayed detachments (3/491, 0.6%) were discovered. Incidence rates of delayed breaks and detachments were 1.8% (5/282) and 0.7% (2/282), respectively, in the retina attending group, 1.0% (1/105) and 1.0% (1/105) in the non-retina ophthalmology attending group, 4.7% (3/64) and 0% (0/64) in the optometrist group, and 2.5% (1/40) and 0% (0/40) in the ophthalmology resident only group. There was no statistically significant difference in the incidence of delayed break or detachment among the staffing groups ($P=0.7312$), but this study was underpowered to detect a statistically significant difference among staffing groups. Patients with a delayed break or detachment were more likely to have lattice degeneration ($P=0.0265$) or a history of retinal break in the contralateral eye ($P=0.0014$), and most eyes (10 [76.9%]) with a delayed break or detachment were left eyes ($P=0.0466$).

Conclusions The overall rate of delayed retinal break or detachment in the current study is similar to previously published rates among retinal physician and retinal fellow examiners. Although no statistically significant difference among staffing groups in the incidence rates of delayed retinal tears or detachments was identified in the study, it is important to note that the optometry and ophthalmology resident only groups had higher incidence rates of delayed retinal breaks than did the retina and non-retina ophthalmology attending groups, and this may be clinically important. Larger cohort studies would be needed in order to have the power to detect statistically significant differences among staffing groups. Varied staffing for acute, symptomatic PVD may assist with resource allocation in similar settings.

Keywords Delayed retinal break · Retinal break · Retinal detachment · Posterior vitreous detachment · PVD · Resident

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Key Messages

- A previous study examining the incidence of delayed retinal breaks after diagnosis of acute posterior vitreous detachment by ophthalmology residents on call in an emergency room reported an incidence rate of 5.3%.
- Our study is larger and examines the potential impact of varied attending staffers on the incidence of delayed retinal break or detachment after diagnosis of acute posterior vitreous detachment in a resident-run clinic.
- We found a delayed retinal break incidence of 2.0% and delayed retinal detachment incidence of 0.6%. There was no statistically significant difference in the incidence rate of retinal break or detachment among staffing groups (P= 0.7312).

Introduction

Posterior vitreous detachment (PVD) is an age-related process defined as the separation between the posterior vitreous cortex and the internal limiting membrane [1]. Patients with symptomatic PVD typically present with photopsias and/or floaters. During PVD development, persistent vitreoretinal traction can lead to formation of retinal breaks and may predispose the patient to retinal detachment if left untreated [2]. In the USA, patients with acute, symptomatic PVD typically undergo dilated funduscopic evaluation with extended binocular indirect ophthalmoscopy including scleral depression at the presenting and follow-up visits. Approximately 8–22% of patients with acute, symptomatic PVD present with a retinal break on initial examination [2–5]. The incidence of delayed retinal breaks following the initial PVD examination has been reported to be approximately 2–5%, with follow-up ranging from 6 weeks to over 1 year [3, 5–13]. A cost-utility decision analysis model which compared a 1-visit versus 2-visit examination schedule for patients who present with acute, symptomatic PVD demonstrated that when considering the cost of scleral buckle for patients expected to develop delayed retinal detachment (based on previously published incidence rates) and the cost of laser retinopexy for delayed discovery of a retinal tear missed initially, there is a significant benefit of a 2-visit examination schedule [14].

Frequency of follow-up visits is based on the patient's risk factors for retinal tear or detachment, and may include at least one follow-up visit within 2 months for symptomatic PVD patients without other significant risk factors for retinal breaks or detachments [5, 7, 13]. Reported risk factors associated with the presence or development of retinal breaks or detachments include presence of pigmented cells in the anterior vitreous, history of phacoemulsification in the affected eye, vitreous hemorrhage, lattice degeneration, high myopia, trauma, and the presence of ten or more floaters on initial presentation or follow-up [5, 15–17]. Vitreous hemorrhage and male gender were reported to be significantly associated with a higher incidence of delayed retinal breaks following diagnosis of acute, symptomatic PVD in one study [3].

PVD formation is insidious and observational studies have demonstrated that this process occurs over decades [1, 18, 19]. There may still be ongoing vitreous traction past the commonly used 6-week follow-up period [1, 3, 13, 19]. A large retrospective study by Uhr et al. found that a significant proportion of delayed retinal breaks (44.5% of all delayed retinal breaks) and detachments (67.5% of all delayed retinal detachments) are identified more than 6 weeks following presentation with acute, symptomatic PVD [3].

In previous studies investigating the incidence of delayed retinal breaks or detachments, examinations of patients who present with acute, symptomatic PVD are performed by retina attendings or retina fellows; this scenario does not necessarily reflect all academic settings or clinics in which residents examine patients independently or staff patients presenting with PVD with attendings of various subspecialties. A 2019 study including 105 patients investigated the incidence of delayed retinal breaks in a resident-run clinic over one year, but did not record a single case of a delayed retinal break or detachment [4]. In a recent study of 228 patients with acute onset of PVD symptoms who were examined by junior ophthalmology residents on call, a 5.3% (13/246) rate of delayed retinal break was reported [20]. Our study aims to examine a larger cohort of patients and to investigate the association of staffing type in a resident-run urgent care clinic (UCC) with the incidence rates of delayed retinal break and delayed retinal detachment.

Methods

The Penn State University Institutional Review Board deemed this study exempt from review and waived the requirement for informed consent by participants. Electronic health records of all patients evaluated in the Penn State Eye Center UCC with a primary diagnosis of PVD including ICD-10 codes H43.811, H43.812, H43.813, and H43.819 from January 1, 2016, to

October 10, 2019, were reviewed. The UCC is a resident-run clinic in the Penn State Eye Center staffed by various ophthalmology subspecialist attendings and optometrists. Patients with a retinal tear or detachment on presentation, with a media opacity precluding thorough peripheral retinal examination, or without a follow-up dilated funduscopic examination within 1 year of presentation were excluded. Patients with atrophic retinal holes on initial examination were included in the study; patients with any other type of retinal break discovered on initial examination were excluded.

The following parameters from each patient were recorded: age, gender, ethnicity, ocular symptoms such as the presence of floaters or flashes of light, laterality of eye with symptoms, history of head trauma, history of a previous retinal break, history of myopia, history of cataract extraction within the past year, history of YAG capsulotomy within the past year, and lens status (phakic, pseudophakic, aphakic) in the affected eye. Ocular examination findings on the initial UCC examination were documented, including the presence or absence of Shafer sign (pigmented cells in the vitreous), associated intraretinal or vitreous hemorrhage, lattice degeneration, vitreoretinal tufts, meridional folds, and atrophic retinal holes.

The type of provider (retina attending, non-retina ophthalmology attending, optometrist, or ophthalmology resident only) who staffed the initial and follow-up visits was recorded. The medical records were reviewed of the presenting examination and of all follow-up examinations through 1 year following the date of presentation with acute PVD in order to identify whether a delayed retinal break or detachment occurred. Patients who presented with a delayed retinal detachment were not also included in the delayed retinal break group. The total length of follow-up, up to the 1-year appointment, was recorded.

Comparisons among the different staffing groups (based on the type of staffing during the patients' presenting visits in the UCC), and between patients with delayed retinal breaks or detachments versus those without delayed retinal breaks or detachments, were assessed using the Chi-square test for categorical variables and analysis of variance for continuous variables. Log-rank test was performed for comparison of survival time-to-events. For all analyses, a P-value < 0.05 was considered statistically significant. The aforementioned statistical analyses were performed using R software (version 4.0.0, The R Foundation, http://www.r-project.org) with package survival (version 3.1–12).

Results

A total of 491 eyes (247 right eyes, 244 left eyes) from 454 patients were included in the study. Demographic and baseline characteristics of the study population are summarized in Table 1. The average age of the patients at presentation was 64.2 years (range: 20–94 years); 295 (65.0%) patients were women and 407 (89.6%) self-identified as white. There were no statistically significant differences in the baseline characteristics among the different staffing groups (all $P > 0.1$; Table 2). The most common presenting symptoms were floaters (421 eyes, 85.7%) and flashes (321 eyes, 65.4%) (Table 1). Patients who developed a delayed retinal break or detachment were more likely to have lattice degeneration or a history of retinal break in the contralateral eye than those who did not develop a delayed break or detachment ($P = 0.0265$; $P = 0.0014$, respectively, Table 1). A significantly higher proportion of delayed retinal breaks or detachments was observed in left eyes (10/13, 76.9%) than in right eyes (3/13, 23.1%) ($P = 0.0466$, Table 1).

The average follow-up duration was 147.4 days; 452 (92.1%) eyes had follow-up for at least 4 weeks, 384 (78.2%) for at least 6 weeks, and 170 (34.6%) for at least 6 months. There was no significant difference among the staffing groups with respect to follow-up duration ($P = 0.2389$; Table 2).

Ten delayed retinal breaks and three delayed retinal detachments were identified, yielding an incidence rate of 2.0% for delayed retinal break and 0.6% for delayed retinal detachment in our cohort (Table 3). There was no case in which two delayed retinal breaks were noted in the same eye. There was one patient who presented with a delayed retinal break in the right eye and a delayed retinal break in the left eye; they were counted as two separate delayed retinal breaks in the analysis. Data regarding the type of delayed break identified and the staffing of the initial examination are provided in Table 4. The incidence rates of delayed retinal break and detachment were 1.8% (5/282) and 0.7% (2/282), respectively, in the retina attending group, 1.0% (1/105) and 1.0% (1/105) in the non-retina ophthalmology attending group, 4.7% (3/64) and 0% (0/64) in the optometrist group, and 2.5% (1/40) and 0% (0/40) in the resident only group (Table 3). There was no statistically significant difference in the incidence rate of delayed retinal break or detachment among the different staffing groups ($P = 0.7312$; Table 3).

The mean duration between presenting examination to identification of a delayed retinal break was 76.8 days (range: 7–322 days) and the mean duration between presenting examination to identification of a retinal detachment was 8.7 days (range: 7–11 days). The mean duration between initial examination to discovery of a delayed retinal break or detachment did not differ significantly among the staffing groups ($P = 0.7047$). Seven of the ten delayed breaks (70%) and all of the delayed retinal detachments were found within 6 weeks of the initial examination; the remaining three out of ten delayed retinal breaks were discovered at 98 (round hole), 150 (slit tear), and 322 (operculated hole) days after the initial examination.

Table 1 Demographic and baseline features of patients with and without delayed retinal break or detachment

	Patients without delayed retinal break or detachment	Patients with delayed retinal break or detachment	*P*-value
Number of eyes (*n,* %)	478, 97.4%	13, 2.6%	-
Age (average, [med, range])	64.3 [20–94]	61.2 [62, 49–72]	.2338
Laterality (*n*, %)			.0466
Right eye	244, 51.0%	3, 23.1%	
Left eye	234, 49.0%	10, 76.9%	
Gender (*n*, %)			.7873
Male	154, 34.8%	5, 41.7%	
Female	288, 65.2%	7, 58.3%	
Race (*n*, %)			.062
Asian	9, 2.0%	1, 8.3%	
African American	12, 2.7%	0, 0%	
Hispanic	13, 2.9%	1, 8.3%	
Caucasian	397, 89.8%	10, 83.3%	
Other	3, 0.6%	1, 8.3%	
2 or more	5, 1.1%	0, 0%	
Declined	3, 0.7%	0, 0%	
Flashes (*n*, %)	312, 65.3%	9, 69.2%	.7672
Floaters (*n*, %)	408, 85.4%	13, 100%	.1364
History of head trauma (*n*, %)	30, 6.3%	2, 15.4%	.4509
Myopia (*n*, %)	115, 24.1%	3, 23.1%	.9359
Family history of retinal detachment (*n*, %)	19, 4.0%	0, 0%	.4630
Pseudophakia (*n*, %)	117, 24.5%	4, 30.8%	.9571
Lattice degeneration (*n*, %)	42, 8.8%	4, 30.8%	.0265
Shafer positive (*n*, %)	19, 4.1%	1, 7.7%	.5035
Associated retinal hemorrhage (*n*, %)	57, 11.9%	2, 15.4%	.6892
Non-obscuring vitreous hemorrhage (*n*, %)	23, 4.8%	2, 15.4%	.2826
YAG capsulotomy in past year (*n*, %)	4, 0.8%	0, 0%	1.00
Number of days from YAG capsulotomy to presenting examination (average, [med, range])	67, [2–214]	-	-
Phacoemulsification in past year (*n*, %)	34, 7.1%	0, 0%	1.00
Number of days from phacoemulsification to presenting examination (average, [med, range])	118.7, [2–386]	-	-
Prior retinal break in fellow eye (*n*, %)	26, 5.4%	4, 30.8%	.0014
History of retinal detachment in fellow eye (*n*, %)	7, 1.5%	0, 0%	1.00
Follow-up duration, days (average, [med, range])	145.7, [126.5, 7–406]	209.8, [210, 28–322]	.2781

Of the patients who underwent YAG capsulotomy within 1 year of presentation with PVD, the mean duration between the YAG capsulotomy and the initial PVD exam was 67 days (range: 2–214 days; Table 1). Of the patients with recent phacoemulsification who subsequently developed PVD, the mean duration between phacoemulsification and the initial PVD exam was 118.7 days (range: 2–386 days; Table 1). None of the patients with a delayed retinal break or detachment underwent phacoemulsification or YAG capsulotomy within 1 year of presentation with acute PVD.

Discussion

To our knowledge, and based on a computerized search of the PubMed literature database, this is the largest study to investigate the incidence of delayed retinal break or detachment among different types of providers (retina attendings, non-retina ophthalmology attendings, optometrists, and ophthalmology residents) who staffed the initial examination of patients who presented with acute, symptomatic PVD. We report an overall incidence of delayed retinal break of 2.0% and of delayed retinal detachment

Table 2 Demographic and baseline features of patients stratified by type of staffing

	Retina attending	Non-retina ophthalmology attending	Optometry attending	Resident only	*P*-value
Number of eyes (*n*), %	282, 57.4%	105, 21.4%	64, 13.0%	40, 8.1%	-
Age (average, [med, range])	64.2 [63.5, 20–94]	64.8 [64, 30–88]	63.8 [64, 47–79]	64 [64, 38–83]	.8896
Laterality (*n*, %)					.4074
Right eye	150, 53.2%	47, 44.8%	32, 50%	18, 45%	
Left eye	132, 46.8%	59, 56.2%	32, 50%	22, 55%	
Gender (*n*, %)					.2813
Male	103, 38.4%	30, 29.7%	17, 28.3%	13, 36.1%	
Female	165, 61.6%	71, 70.3%	43, 71.7%	23, 63.9%	
Race (*n*, %)					.4386
Asian	6, 2.2%	0, 0%	3, 5.0%	0, 0%	
African American	9, 3.4%	3, 3.0%	0, 0%	0, 0%	
Hispanic	8, 3.0%	6, 5.9%	0, 0%	1, 2.8%	
Caucasian	238, 88.9%	89, 88.1%	56, 93.3%	33, 91.7%	
Other	3, 1.1%	1, 1.0%	0, 0%	1, 2.8%	
2 or more	3, 1.1%	1, 1.0%	0, 0%	1, 2.8%	
Declined	1, 0.37%	1, 1.0%	1, 1.7%	0, 0%	
Flashes (*n*, %)	182, 64.5%	65, 61.9%	42, 65.6%	32, 80%	.2189
Floaters (*n*, %)	235, 83.3%	93, 88.6%	57, 89.1%	36, 90%	.3623
History of head trauma (*n*, %)	19, 6.7%	5, 4.8%	7, 10.9%	1, 2.5%	.2943
Myopia (*n*, %)	66, 23.4%	27, 25.7%	17, 26.6%	8, 20%	.8484
Family history of retinal detachment (*n*, %)	12, 4.3%	1, 0.95%	2, 3.1%	3, 7.5%	.2422
Pseudophakia (*n*, %)	69, 24.5%	28, 26.7%	16, 25%	8, 20%	.8720
Lattice degeneration (*n*, %)	23, 8.2%	12, 11.4%	4, 6.25%	7, 17.5%	.1823
Shafer positive (*n*, %)	13, 4.6%	4, 3.8%	3, 4.7%	0, 0%	.4702
Associated retinal hemorrhage (*n*, %)	41, 14.5%	10, 9.5%	5, 7.8%	2, 5%	.1508
Non-obscuring vitreous hemorrhage (*n*, %)	17, 6.0%	4, 3.8%	4, 6.25%	0, 0%	.3651
YAG capsulotomy in past year (*n*, %)	4, 1.4%	0, 0%	0, 0%	0, 0%	.3961
Number of days from YAG capsulotomy to presenting examination (average, [med, range])	67, [2–214]	-	-	-	-
Phacoemulsification in past year (*n*, %)	15, 5.3%	12, 11.4%	4, 6.25%	3, 7.5%	.2124
Number of days from phacoemulsification to presenting examination (average, [med, range])	95, [19–279]	102.4, [2–259]	248.5, [266.5, 57–386]	163.7, [175, 77–239]	-
Prior retinal break in fellow eye (*n*, %)	17, 6.0%	6, 5.7%	4, 6.25%	3, 7.5%	.9825
History of retinal detachment in fellow eye (*n*, %)	4, 1.4%	0, 0%	2, 3.1%	1, 2.5%	.3654
Follow-up duration, days (average, [med, range])	153.5, [131.5, 7–401]	150.5, [7–406]	134.9, [18–385]	119.5, [61.5, 10–356]	.2389

of 0.6%; these rates are comparable to other studies which reported an incidence of 2–5% for delayed retinal break and an incidence of about 1% for delayed retinal detachment [3, 5–13]. Our study did not identify a statistically significant difference in the incidence of delayed retinal break or detachment among the different staffing groups ($P = 0.7312$; Table 3), although the power of the comparisons is limited by sample size.

Three (30%) of the delayed retinal breaks were noted more than 6 weeks after presentation in two patients with acute symptomatic PVD (round hole at 98 days, slit tear at 150 days, and operculated hole at 322 days); the remaining delayed retinal breaks (70%) and all three retinal detachments (100%) were discovered within 6 weeks of presentation with acute PVD. One patient was found to have two delayed breaks discovered past 6 weeks: a delayed round

Table 3 Incidence and timing of delayed retinal break/detachment, stratified by type of staffing

	Retina attending	Non-retina ophthalmology attending	Optometry attending	Resident only	*p*-value
Number of eyes (*n,* %)	282, 57.4%	105, 21.4%	64, 13.0%	40, 8.2%	-
Delayed breaks or detachments (*n*, %)	7, 2.5%	2, 1.9%	3, 4.7%	1, 2.5%	.7312
Delayed breaks (*n*, %)	5, 1.8%	1, 1.0%	3, 4.7%	1, 2.5%	.3895
Number of days from presenting examination to delayed break (average, [med, range])	98.8, [7–322]	150, [150, 150]	27.7 [15–41]	41 [41, 41]	.7047
Delayed detachments (*n*, %)	2, 0.7%	1, 1.0%	0, 0%	0, 0%	.8077
Number of days from presenting examination to delayed detachment (average, [med, range])	9.5 [9.5, 8–11]	7, [7, 7]	-	-	.8303

hole in the right eye at 98 days and a delayed retinal tear in the left eye at 150 days during the same visit for follow-up of bilateral PVD; she underwent laser barricade for both breaks. Another patient was noted to have an operculated hole at 322 days. Both of these patients with delayed breaks past 6 weeks were female and had a history of myopia. The first patient with a round hole and slit tear was also noted to have lattice degeneration on her initial examination. Neither of these patients had any other known risk factors for retinal break or detachment, and both patients had undergone several dilated fundus examinations with scleral depression prior to the discovery of the delayed retinal break(s).

Although there was not a statistically significant difference in time from initial examination to discovery of a delayed retinal break among the staffing groups, the average time from initial examination to discovery of a delayed break was approximately two to four times larger in the retina attending or non-retina ophthalmology attending groups compared to the optometry attending or resident groups (Table 3). This may suggest that the delayed breaks discovered in the retina attending and non-retina ophthalmology attending groups were more likely new onset breaks rather than missed retinal breaks on the initial examination.

In our study, lattice degeneration was present in a significantly higher proportion of eyes with a delayed retinal break or detachment (30.8%) than in eyes without a delayed retinal break or detachment (8.8%) ($P=0.0265$, Table 1). Although lattice degeneration has not been previously associated with formation of delayed breaks or detachments in other studies investigating delayed retinal breaks [3], lattice degeneration has been associated with the presence of a rhegmatogenous retinal detachment, especially in the setting of an acute PVD [21]. Retinal breaks associated with lattice degeneration typically occur at the ends or posterior margins of the lattice lesions, and may result from increased vitreoretinal traction during PVD formation [22].

Our data also demonstrate that a history of a retinal break in the fellow eye was significantly associated with the development of a delayed retinal break or detachment ($P=0.0014$, Table 1). Patients with a history of rhegmatogenous detachment in one eye have been shown to have an increased risk of retinal detachment in the fellow eye [23]. Similarly, patients with a history of retinal break in the fellow eye may have a predisposition to formation of a new retinal break or detachment.

Although the proportion of right and left eyes with acute, symptomatic PVD included in our study was approximately equal, a significantly higher proportion of delayed retinal breaks or detachments was observed in left eyes (10/13, 76.1%) than in right eyes (3/13, 23.1%) ($P=0.0466$, Table 1). While this may represent a spurious finding due to chance, this might also be because the typical configuration

Table 4 Type of delayed retinal break stratified by type of staffing

	Delayed retinal breaks/detachments	Retina attending	Non-retina ophthalmology attending	Optometry attending	Resident only
Delayed retinal breaks (*n*, % of all breaks)	10, 100%	5, 50%	1, 10%	3, 30%	1, 10%
Round hole(s) (*n*, % of all breaks)	2, 20%	1, 20%	0, 0%	1, 33.3%	0, 0%
Operculated hole(s) (*n*, % of all breaks)	3, 30%	2, 40%	0, 0%	0, 0%	1, 100%
Retinal tear(s) (*n*, % of all breaks)	5, 50%	2, 40%	1, 100%	2, 67.7%	0, 0%
Delayed retinal detachments (*n*, % of all detachments)	3, 100%	2, 67.7%	1, 33.3%	0, 0%	0, 0%

of an eye examination lane for a right-handed eye care provider has the provider's chair and indirect ophthalmoscope to the patient's right side so that when binocular indirect funduscopic examination with scleral depression is performed, the examiner's view may extend further to the nasal periphery for right eyes than left eyes unless the examiner, instead of remaining on the patient's right side and leaning over the patient to obtain a view to the far nasal periphery in each eye, performs a peripheral retinal examination from both sides of the patient. None of the previously published studies of delayed retinal breaks and detachments consistently reports the laterality of the eyes with delayed retinal break or detachment.

A larger proportion of female (65.0%) compared to male patients (35.0%) was noted among the patients who presented with acute, symptomatic PVD. This phenomenon has been noted in several studies of patients with symptomatic PVDs [7–9, 24, 25]. Observational studies using optical coherence tomography (OCT) have demonstrated more rapid PVD progression in female patients compared to age-matched male patients past 60 years of age, and this may explain, at least in part, why women have a higher prevalence of idiopathic macular holes and symptomatic PVD due to vitreoretinal traction [26].

Our study has several limitations. Due to the retrospective nature of this study, data for some variables examined are incomplete. For example, the degree of myopia was not specified in the medical records of all patients, and the presence or absence of Shafer sign was not recorded in all notes. The presence of myopia was based on documentation by the eye care providers who examined the patients (there was no specific study definition for myopia). As there was inconsistent documentation of patients' refractive correction, it was not possible to determine how many patients had mild, moderate, or high myopia. Further, 107 (21.8%) eyes in our study were followed for less than 6 weeks and this may have led to an underreporting of delayed retinal breaks or detachments; however, the majority of delayed retinal breaks (7/10, 70%) and all of the delayed retinal detachments (3/3, 100%) in our study were discovered before 6 weeks and the proportion of eyes in our study followed for longer than 6 weeks (384/491, 78.2%) is higher than that reported in other studies investigating the incidence of delayed retinal breaks or detachments, with most studies having no follow-up past 6 weeks [3, 6, 10]. Our study included a review of follow-up examinations up to the 1 year visit after presentation with acute PVD, and previous studies demonstrated that almost all delayed retinal breaks or detachments were detected within 1 year (90th percentile of one large-scale study was 307 days) [3, 6–13]. Another potential limitation of this retrospective study is the lack of a standard follow-up protocol among various attendings throughout the study. However, the impact of this potential study limitation on the study results is expected to be small for two reasons: (1) it is standard protocol in the Penn State Eye Center UCC for patients diagnosed with acute, symptomatic PVD to be scheduled for a follow-up examination 4–6 weeks after the presenting examination (beyond this 4–6 week examination, follow-up among attendings may vary); and (2) the majority of delayed retinal breaks (7/10, 70%) and all of the delayed retinal detachments (3/3, 100%) in our study were discovered before 6 weeks. Another study limitation is that our data are derived from a single clinic within an academic institution which may limit the generalizability of our results. We serve a predominantly Caucasian population, as noted in Table 1, and this may not reflect the patient demographics in other regions of the United States. Further, the sample size in each staffing group limits the power of this study to detect statistically significant differences among the groups. For example, based on calculations performed using nQuery + nTerim 4.0 software using a set alpha value of 0.05 and beta value of 0.20, and assuming a two sided Chi-squared test and excluding patients who had a prior tear, a total of 4,854 eye examinations would be required to detect a statistically significant difference in incidence rates of delayed retinal break between experienced ophthalmologists (retina attendings and non-retina ophthalmology attendings) versus less experienced ophthalmologists (residents) and optometrists. Thus, although no statistically significant difference among staffing groups was identified in this study, it is important to note that the optometry (4.7%) and resident (2.5%) groups had a higher overall incidence rate of delayed retinal breaks than the retina (1.8%) and non-retina ophthalmology (1.0%) attending groups, and this may be clinically important. Larger cohort studies would be needed in order to have the power to detect statistically significant differences among staffing groups. Finally, resident comfort level with examination of the peripheral retina likely differs by training level. Most (36/40, 90%) of the resident-only examinations in the current study were performed by residents in their PGY3 year; the patient with a delayed retinal break (operculated hole) in the resident only group was examined by a PGY3 resident. Our study demonstrates a delayed retinal tear rate among ophthalmology residents (2.5%) comparable to previously published rates which included retinal physicians and retinal fellows (2–5%) [3, 5–13, 20].

Our study results do not demonstrate a statistically significant difference in incidence rates of delayed retinal breaks or detachments among retina attendings, non-retina ophthalmology attendings, optometrist attendings, or ophthalmology residents. However, the optometrist and ophthalmology resident only groups had higher incidence rates of delayed retinal breaks than did the retina and non-retina ophthalmology attending groups, and this may be clinically important.

Patients with lattice degeneration or a history of retinal break in the fellow eye were at higher risk of delayed retinal break or detachment, and most delayed breaks or detachment occurred in left eyes. Future larger studies are warranted and may elucidate other associated risk factors.

Availability of data and material All data generated or analyzed during this study are included in this article.

Code availability Not applicable.

Declarations

Ethics approval This study was deemed exempt from further review by the Penn State College of Medicine Institutional Review Board.

Conflict of interest Dr. Scott serves as Principal Investigator and Chair of the *S*tudy of *CO*mparative Treatments in *RE*tinal Vein Occlusion *2* (SCORE2) trial, which is funded by the National Eye Institute, has served as a consultant for Regeneron, and has served on the Data and Safety Monitoring Committee for clinical trials sponsored by Novartis (these disclosures are unrelated to the present work). None of the other authors report any financial disclosures or financial conflicts of interest.

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