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Prevalence Comparison of posterior vitreous detachment and its types based on patients' demographic characteristics at Razi Clinic in Birjand City

Abstract

Posterior vitreous detachment (PVD) is a disorder in which, mostly following the physiological process of aging, by itself causes annoying eye symptoms.. If it is not treated early, it can lead to irreversible complications such as retinal tears and detachment. The present study was conducted to investigate the prevalence and characteristics of acute PVD and its complications.

60 patients (men and women) was selected among patients referring to Razi Ophthalmology Clinic in Birjand City. A detailed ophthalmic examination was performed including optical coherence tomography (OCT). Incomplete PVD was differentiated into stage 1 (shallow PVD with circular perifoveal vitreous attachment), stage 2 (PVD reaching fovea but not foveola), stage 3 (shallow PVD with pinpoint vitreous attachment at the foveola), and stage 4 (PVD completely detached from the macula,not attached to the optic disc).The current study includes 60 patients with a mean age of 62.42 ± 10.47 years consisting of 34 females (56.7%) and 26 (43.3%) males. Stage 1 PVD was seen in 20 (38.3%) eyes, Stage 2 PVD in 8 (11.7%) eyes, Stage 3 PVD in 14 (20%) eyes, and Stage 4 PVD in 18 (30%) eyes. Females were more likely to have complete PVD ($p = 0.04$). The stage of PVD after a sudden occurrence of posterior vitreous detachment can be used as a prognostic factor to predict the prognosis of acute PVD patients. Age and female gender are independently associated with complete PVD occurrence.

Keywords: *posterior vitreous detachment, optical coherence tomography, complication, Retinal detachment*

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Introduction

Almost 80% of the volume of the eyeball is occupied by the vitreous, which is an avascular, transparent, and jellylike tissue containing water (98%), collagen, and hyaluronic acid (2%) that consists of two main parts, the central nucleus, and the peripheral cortex. Naturally, the peripheral part is firmly connected to the retina in the ora serrata area, the optic nerve, and large vessels.

The vitreous base is a band 4 mm wide that lies on the oraserrata and pars plana and is connected to them by numerous filaments. Due to the tight connection of the vitreous base, the vitreous cortex detachment from the retina in this area can be accompanied by retinal cavitation.

The vitreous undergoes physical and biochemical changes with age. The most important of these changes is vitreous liquefaction (syneresis), in which the liquid component is detached from the collagen scaffold and forms numerous cavities. Posterior vitreous detachment (PVD) occurs when the syneresis cavity enters the space between the vitreous cortex and the retina, which is accompanied by the weakened posterior connection between the vitreous cortex and the retinal internal limiting lamina. This event at the bedside leads to the appearance of symptoms such as myodesopsia (floating spots in front of the eyes that are expressed as spider webs or fly whisk) and photopsia (luminous sparks in the visual field in the absence of a real light source) in the affected person. Moreover, peripapillary, posterior hyaloid membranes or the Weiss ring may be seen completely in the examination of the affected eye.3

Many vision problems caused by PVD will improve over time after a few weeks; even some affected people experience no special symptoms and will probably never notice this event. However, it has been associated with eye complications (e.g., retinal tears, macular holes, and vitreous/retinal bleeding in some people, especially in the early stages of PVD symptoms and expansion and no early management. The prevalence of complications in people with symptomatic PVD is reported from 8.2% to 47.6% in different studies.

Retinal detachment (RD) may occur within 6 weeks of PVD incidence in untreated retinal breaks. During this period, it is also possible to find new retinal breaks in different regions. For this reason, the patient re-examination in 6 weeks is recommended in many studies. RD requires immediate surgical intervention to prevent photoreceptor apoptosis and irreversible vision loss.4

Compared to PVD without vitreous hemorrhage, there is an increased risk of retinal tears in PVD with vitreous hemorrhage. According to earlier research, retinal tears affect between 50 and 70 percent of PVD patients who experience problems from vitreous hemorrhage. On the other hand, only 7–12% of PVD patients who do not have vitreous hemorrhage also have a retinal tear. Furthermore, only vitreous pigment or granules are observed in acute PVD patients seven times more frequently than in individuals without retinal tears.

Most people with PVD are aged 50 years or older, and this disease is more prevalent after the age of 80 years. Although men and women suffering from this eye disease are reported

to have somewhat identical possibilities in previous reports, PVD seems to appear more progressive in women.

According to previous studies, the factors that probably aggravate the occurrence of PVD, its complications, and its incidence at a younger age include diabetes, cataracts, glaucoma, myopia, a history of eye surgeries, and eye injury and trauma.

To further investigate the process involved in the formation of floating particles in the eyes as a common complaint of patients and to analyze the development of acute symptomatic PVD in a retrospective study, Gisung Son et al. (2020) examined the medical records of patients who suffered from vitreous floater in their lives for the first time. The results of this study confirmed several facts about PVD that were also reported in other studies, including the first vitreous floaters in life occurring in middle age (average age 58.4). In this study, the predominance of PVD in women (72%) and the earlier onset of PVD in myopic eyes are also reported in several other studies.

In Spain, Carrero et al. (2012) investigated the prevalence and clinical correlations of incomplete PVD in a study with a prospective cohort approach. Of the 207 people included in this study, 54 (26%) and 153 (73.9%) people had incomplete and complete PVDs, respectively. The patients were followed up for 4-8 years, and retinal tears occurred in five patients, with one person suffering from complete PVD. The epimacular membrane was formed in 12 patients. The authors concluded that PVD-related delayed complications were more frequent in people with incomplete PVD than complete PVD.

Talor et al. (2017) analyzed the prevalence rate and predictive factors of PVD disorder using a retrospective analysis of medical records in patients with PVD, retinal tear, or vitreous hemorrhage in the ophthalmology ward of the level III ophthalmology hospital affiliated with Sahlgrenska University in Sweden. In this study, the most striking clinical assessment-related finding was that patients seeking care on the first day of symptom onset would eventually notice a retinal tear more significantly than those waiting for care on subsequent days or at a later time (41% vs. 25%). This reflects the presence of more noticeable symptoms in PVD associated with retinal tears.

In a Beijing eye cross-sectional study conducted in northern China, Shao et al. (2011) aimed to determine PVD prevalence and related issues. They concluded that the prevalence of incomplete PVD, which was observed in 67% of the study population, was significantly correlated with youngness, maleness, residence in rural areas, a larger corneal diameter, and myopic vision of people.

Schwab et al. (2012) evaluated the relationship between gender and age with the PVD development. In this observational cross-sectional study, 335 eyes without refractive disorder (216 women and 119 men) were examined by ultrasound (US) and optical coherence tomography (OCT). The results indicated the decreased prevalence of foveal attachment with increasing age. The prevalence of PVD was not significantly different in both genders; only women with late-stage PVD were significantly older than men. Another observation was the sudden increase in the prevalence of advanced-stage PVD between the ages of 70 and 75 years. The use of US and OCT led to the diagnosis of complete or incomplete PVD in 80% of eyes.

The prevalence and factors affecting PVD, as well as the prevalence of blindness and other visual impairments were investigated in a community-based study in a rural population of northern China (Shen et al. (2013). It was concluded that age and gender were not significantly related to the probability of PVD incidence.

The effect of oxidative stress in glaucoma on the vitreous and incidence of PVD was studied at the Department of Ophthalmology, University of Graz, Australia (Schwab et al. 2016). In this study, the vitreous status in 48 glaucoma patients with an average age of 66 years was evaluated clinically using ultrasound and OCT, and the patients were divided into three levels, namely the absence of PVD, early PVD, and advanced stages of PVD. The obtained data were compared with the available data of 101 people without glaucoma (with an average age of about 73 years) as a control group after corresponding both groups (based on age and gender). For both groups, the inclusion criteria were the presence of a lens with an axial length of 5.21-5.24 mm, age over 18 years, and the absence of retinal diseases (e.g., macular pucker, age-related macular degeneration, and the absence of notable cataracts), evidence or history of intraocular vascular occlusion or inflammatory diseases, no intraocular surgery or laser coagulation, no history of previous eye trauma, and no diabetes mellitus. Finally, it was shown that the prevalence of high-degree PVD in glaucoma patients was significantly higher than in the control group. This observation could be probably explained by occurring glaucoma-induced oxidative stress in the adjacent layer of the vitreous that polymerizes hyaluronic hydroxyl radicals, thereby increasing the vitreous liquefaction, free radical accumulation, and finally the incidence of PVD.

Although no significant relationships were observed between the presence of PVD and the incidence of glaucoma in previous studies, this study showed that the presence or absence of PVD could be a valuable finding for glaucoma diagnosis. This disagreement can be explained by the accuracy of this study in PVD diagnosis through the simultaneous use of ultrasound and OCT, while PVD was diagnosed only based on clinical findings in other studies. To find out if PVD may be utilized to enhance existing glaucoma

screening, more investigation is necessary. The purpose of the current study was to assess the prevalence of acute PVD and any potential correlations among Razi Clinic patients in Birjand City. There are helpful suggestions given for assessing potential and established risk factors for PVD.

Materials and methods

The statistical population in this cross-sectional study was made up of those who were referred to Birjand City's Razi Ophthalmology Clinic. The patients requested a standard ophthalmological appointment and examination or complained of a specific issue, such as experiencing abrupt sparks in their eyes or seeing stationary or moving light points. Sixty people (men and women) were selected to participate in the study through the convenience method after obtaining informed consent according to the inclusion and exclusion criteria of the study as follows.

Inclusion criteria:

1) Less than 3 months after the onset of symptoms in a patient diagnosed with PVD,

2) The presence of a lens with an axial length of 21.5-24.5 confirmed by biometrics

3) Absence of vitreoretinal diseases, including macula pucker, age-related macular degeneration, and branch or central vein thrombosis,

4) The possibility of performing a successful OCT.

Exclusion criteria

1) The patient had a known case of PVD with more than 3 months since the onset of symptoms

2) The person's reluctance to participate in the study

To initiate the study, a complete history and records of accompanying diseases, including the history of eye diseases, diabetes, HTN, smoking, alcohol consumption, etc., were obtained from the participants in the study. Visual acuity was measured by an optometrist using a biometry device, and the refractive errors of the eyes were defined based on spherical equivalent = sphere + cylinder⁄2. Severe, moderate, and mild myopia/hypermetropia levels were defined as SE < −6.0D, SE ≥ ±6.0D ≤ ±1.0D, and SE > ±1.0D. Then, both eyes were completely examined using a slit-lamp by a retinal specialist after the pupils were dilated to at least 6 mm using tropicamide drops. Next, both eyes of the subjects were evaluated through dilated pupils using the OCT device (brand) available in the imaging center of the Razi Clinic.

According to the findings obtained from the evaluations and using the classification presented by Kakehashi et al. (2014), the subjects were divided into four groups according to the degree of vitreous involvement as follows:

1) Stage 1: perifoveal PVD is characterized by focal perifoveal PVD in three or fewer quadrants. At this stage, persistent attachment to the vitreous cortex occurs in the fovea, optic nerve head, and middle peripheral retina.

2) Stage 2: macular PVD, which is similar to the previous stage but is associated with perifoveal PVD in all four retinal quadrants.

3) Stage 3: near-complete PVD, in which the vitreous cortex is not connected to the surface of the fovea. However, it attaches persistently to the optic nerve head and middle peripheral retina.

4) Stage 4: complete PVD, which is also characterized by a prominent Weiss ring on slit-lamp examination.

To further investigate the relationship between possible complications and risk factors, data were compared in two general groups complete PVD (including stage 4 of involvement) and incomplete PVD (including stages 1, 2, and 3 of involvement). Possible complications of PVD, including retinal tear, RD, macular perforation, and vitreous and retinal bleeding, were evaluated and recorded in individual patients. Accordingly, the subjects were also divided into two groups of patients with and without complications, and the demographic indicators were compared between the two groups.

Finally, the collected data were statistically evaluated in SPSS software version 26. Gender and average age between the groups were compared using the one-way ANOVA test. The incidence of complications and the relationship between PVD and demographic factors were predicted with the odds ratio at the 95% confidence interval.

Results

Of the 60 studied patients, 20 (23.3%), 8 (9.3%), 14 (16.2%), and 18 (20.9%) patients were in stages 1, 2, 3, and 4 of the disease, respectively. Therefore, incomplete and complete PVDs are respectively observed in 48.8% and 20.9% of cases in this study.

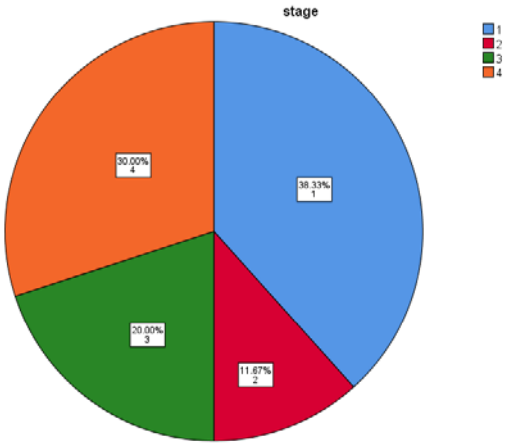

Figure 1. The pie chart of disease stage distribution

Gender distribution in the subjects

In this study, 33 (56.7%) and 27 (43.3%) patients were women and men, respectively. The gender frequency distribution of each stage is shown in Table 1. No significant difference was seen between the different groups of the disease stage in terms of gender-based on Fisher's Exact test (p-value = 0.0238).

Table 1. Examination of gender frequency in each group based on the disease stage

Stage		Frequency	Percent	Cumulative Percent
1	**Female**	8	43.5	43.5
	Male	12	56.5	100.0
	Total	20	100.0	
2	**Female**	3	28.6	28.6
	Male	5	71.4	100.0
	Total	8	100.0	
3	**Female**	9	66.7	66.7
	Male	5	33.3	100.0
	Total	14	100.0	
4	**Female**	13	77.8	77.8
	Male	5	22.2	100.0
	Total	18	100.0	

Age distribution in the subjects

In this study, the age of the studied patients averaged 62.42 ± 10.47 years. The age distribution in each stage is shown in Table 2. According to the non-normal age distribution based on the Kolmogrov-Smirnov test, significant differences in terms of age between different groups based on stage were evaluated using the Kruskal-Wallis test, which indicated no significant differences between the groups (p-value = 0.264).

Table 2. Age distribution in each group based on disease stage

Stage	N	Minimum	Maximum	Mean	Std. Deviation
1	20	33	82	62.87	11.323
2	8	42	68	56.71	9.050
3	14	38	81	63.00	12.277
4	18	33	82	58.78	13.567

Examination of gender distribution based on complete or incomplete PVD

In this study, 20 (47.6%) out of 42 incomplete PVD and 14 (77.8%) out of 18 complete PVD cases belonged to women. The Z-test for independent proportions indicated a significant difference (p-value = 0.046) in terms of a higher proportion of women in complete PVD.

Table 3. Gender distribution based on complete PVD and incomplete PVD groups

			Incomplete PVD	Complete PVD	
Sex	Female	Count	20	14	34
		% within PVD status	47.6%	77.8%	56.7%
		% of Total	33.3%	23.3%	56.7%
	Male	Count	22	4	26
		% within PVD status	52.4%	22.2%	43.3%
		% of Total	36.7%	6.7%	43.3%
Total		Count	42	18	60
		% within PVD status	100.0%	100.0%	100.0%
		% of Total	70.0%	30.0%	100.0%
		Value	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square		4.667[a]	.031	.046	.029
Continuity Correction[b]		3.520	.061		
Likelihood Ratio		4.909	.027	.046	.029
Linear-by-Linear Association		4.589[c]	.032	.046	.029
N of Valid Cases		60			

Examination of age distribution based on complete or incomplete PVD

In this study, the participants' age averaged 61.88 ± 11.256 and 58.78 ± 13.56 years in 42 cases of incomplete PVD and 18 cases of complete PVD, respectively. Due to the non-normal distribution, the use of the Mann-Whitney U test indicated no significant difference between the average ages of the two groups.

Table 4. Age distribution based on complete PVD and incomplete PVD groups

	PVD status	N	Mean Rank	Sum of Ranks
Age	Incomplete PVD	42	31.65	1329.50
	Complete	18	27.81	500.50

	PVD			
	Total	60		
		Age		
Mann-Whitney U		329.500		
Wilcoxon W		500.500		
Z		-•.784		
Asymp. Sig. (2-tailed)		•.433		

Conclusion

Spontaneous PVD is a benign disease associated with increasing age in patients aged over 45 years. In previous studies, a prevalence of about 24% was reported among patients aged 50-59 years, with an increase of about 87% in 80-90 years of age.

Recent studies have provided new explanations of the underlying mechanisms of physiological and complicated PVD. Extensive changes occur in the vitreous body with aging. Reduced gel volume and increased liquid volume are the outcomes of the vitreous consistency shift from the gel phase to the liquid phase. Twenty-five percent of the vitreous at the age of fifty, and eighty-two percent at that age, are in the liquid phase. When the vitreous abruptly separates from the retina's inner limiting membrane, acute PVD takes place.

Research suggests that in their early stages, up to 20% of PVDs may not exhibit any symptoms and go undetected by a clinician.8 Even though they could stay simple for months or years after PVD first appears, acute PVD can lead to the development of symptoms like flushing, floating dots in the field of vision, and visual abnormalities. Flashes of light are fast and are often caused by retinal irritation or retinal stretching.4

In this study, the rate of complications, such as retinal tear, retinal detachment, and vitreous hemorrhage was higher in the complete PVD group than that of those with less involved stages (P = 0.04). Some retrospective studies investigating the prognostic factors of PVD show that patient complaints about the severity of symptoms are related to the onset or subsequent development of retinal tears. Since prompt diagnosis and treatment can avoid irreversible vision loss, eye examination is therefore crucial for patients with acute symptoms or episodes of worsening symptoms, especially for those with several recognised risk factors for problems. Two prospective and controlled studies revealed that late retinal tears occurred in 3.7%-5.2% of patients after PVD presentation. Byer reported the occurrence of this event several years after the symptoms of PVD.

According to the studies conducted in the past years, the most important risk factors for the occurrence of PVD and the exacerbation of its complications include increasing age, female gender, myopia, diabetes, eye trauma, and history of eye surgeries.[9, 10, 11, 12]

As expected from the pathophysiology of the disease, the increased rate of PVD with age in this study was consistent with previous reports. In a postmortem study, Foos found PVD in one or both eyes in subjects aged 20-49 years (0.4%), 50-59 years (7.2%), 60-69 years (22%), and 70 years or more (60%). Hayre found that this frequency increased from 4.7% in people aged less than 45 years to 20.4% in those aged 45-65 years and to 58.4% in individuals aged over 65 years.

Foos and Hayreh also found that PVD was significantly more frequent in women than men and was even influenced by other factors such as age and refractive error. Furthermore, PVD-related macular damage occurred at a younger age in women. However, our study revealed no significant gender differences between subjects with different stages of PVD, but women were generally more frequently affected by complete PVD (p = 0.04), the reason of which is not clear. As described by Larson, the relatively reduced hyaluronic acid concentration in women's eyes may explain the difference in the prevalence of PVD between women and men.

In the study of complicated patients, the comparison of age based on gender did not show significant differences. According to previous studies, however, women seem to be affected by the faster progression of PVD. As such, menopausal women are more prone to PVD due to estrogen deficiency, which may have a protective effect against PVD and its complications. According to Mitry et al., men were more likely than women to experience RD after acute PVD (incidence rates of 13.09 and 7.41 per 100,000, respectively).

Although severe myopia was not associated with the prevalence of PVD in this study, the age of PVD onset might be earlier in eyes with severe myopia than those with low myopia or normal eyes (Fig. 3). The lower rate (11.7%) of severe myopia in the population may statistically reduce the detectability of this association. However, previous studies evidenced increasingly developed PVD with higher degrees of myopia. This fact can be explained in relation to changes in the eyeball with the progression of PVD. The axial length is longer in myopic eyes, hence they may be easily affected by the vitreous body shrinkage and light spots and floaters appear earlier than in non-myopic eyes.

There are limitations and advantages in this study, in which accurate records were taken from patients' information. Unlike many studies in which PVD is diagnosed by the slit-lamp examination depending on the examiner, PVD was diagnosed and staged by OCT according to the latest available standards, which has high accuracy in the diagnosis of this lesion in the central retinal areas. However, the non-random study population referring to the specialized clinic,

the small sample size, and a single center are among the limitations of this study. Other limitations of this study include the cross-sectional nature of the study and no follow-up of patients in terms of the occurrence of late complications. For this reason, it was not possible to more accurately compare the groups in terms of the occurrence of complications.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest

Ethics statement

The studies involving human participants were reviewed and approved by Ethical Committee of Birjand Universitf Medical science

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