Suprachoroidal hemorrhage associated with pars plana vitrectomy

Bin Mo
Beijing Tongren Hospital
Song-Feng Li (Lsf_0309@163.com)
Beijing Tongren Hospital
Yi Liu
Beijing Tongren Hospital
Jun Zhou
Beijing Tongren Hospital
Shao-Li Wang
Beijing Tongren Hospital
Xiang-Yu Shi
Beijing Tongren Hospital

Research Article

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Abstract

Purpose

To analyze the characteristics, related risk factors, and prognosis of suprachoroidal hemorrhage (SCH) associated with pars plana vitrectomy (PPV).

Methods

Cases of SCH associated with PPV excluding trauma were retrospectively analyzed in Beijing Tongren Hospital between January 2010 and June 2020. General data were collected including general data, myopia status, axial length, state of crystalline lens, onset time of SCH, range, treatment method, visual prognosis, and methods of operation and anesthesia. Patients were divided into those with SCH related to first PPV (Group 1), and SCH related to second intraocular surgery in vitrectomized eye (Group 2). Patients were also categorized by the onset time of SCH as expulsive suprachoroidal hemorrhage group (ESCH), and delayed suprachoroidal hemorrhage group (DSCH).The general data, related risk factors, and the visual prognosis of SCH in different groups were analyzed.

Results

SCH associated with PPV was studied in 28 cases; 16 male and 12 female. The mean age of the patients was (53.51 ± 10.21) years old, and the mean follow-up time (24.94 ± 14.60) days, mean axial length was (28.21 ± 3.14) mm. Of these cases, 21 was high myopia, 25 was aphakia/ pseudophakic, and 7 had focal hemorrhage. Silicone oil removal had the highest occurrence with 12 cases (43%). Patients in Group 2 were younger than Group 1 ($P = 0.005$). In terms of treatment and prognosis, 5 eyes were simply closely observed, 4 given single suprachoroidal drainage, 15 given suprachoroidal drainage combining silicone tamponade, 2 undergoing anterior chamber puncture, and 2 giving up treatment. A follow-up vision: NLP ~ 20/30; 2 eyes with NLP (7.14%), 6 of ≥ 20/200 (21.43%). The final outcomes presented a significantly positive correlation with baseline vision, but no significant correlation with age or axial length.

Conclusions

SCH has a higher incidence rate after a second intraocular surgery in a vitrectomized eye which is associated with the lack of vitreous support and easier fluctuation of intraocular pressure. SCH associated with PPV is more localized and has a relatively good prognosis; high myopia and aphakic/ pseudophakic eyes are risk factors. Active treatment can effectively improve visual prognosis.

Trial registration:

Retrospective case series study, not applicable.

Backround

Suprachoroidal hemorrhage (SCH) is a rare but serious threat to vision, and is one of the most severe complications during or after intraocular surgery [1]. According to onset time, SCH can be divided into intraoperative expulsive suprachoroidal hemorrhage (ESCH) and post-operative delayed suprachoroidal hemorrhage (DSCH) [2]. According to the hemorrhage range, it can be divided into focal or diffuse SCH [3]. Blood in the suprachoroidal space can infiltrate into the inferior retina, vitreous body, and anterior chambers, causing severe damage to the function of ocular tissue, retinal proliferation, and tractional detachment of retina, resulting in complete loss of vision. Furthermore, massive SCH for an extended period can cause cyclodialysis and functional loss of the ciliary body, leading to eventual eyeball atrophy [4, 5].

The incidence rate of SCH varies with different procedures, while the related risk factors and prognosis are also slightly different. As previously reported in the literature, the incidence rate of SCH in vitreous and retinal surgeries is 0.09–4.3% [6–8]. However, there are few reports of SCH associated with pars plana vitrectomy (PPV), or SCH related to second intraocular surgery in vitrectomized eyes. Herein we have summarized and analyzed cases of SCH associated with PPV from the last 10 years, including the related risk factors and prognosis.

Methods

Patients

We retrospectively analyzed 28 cases of SCH associated with PPV from patients treated in Beijing Tongren Hospital between January 2010 and June 2020. Patients with eye trauma-related SCH were excluded. This study was consistent with the Declaration of Helsinki.

General data were collected, including gender, age, full medical history, anticoagulant use, condition of the eyes including past surgery, high myopia, axial length, state of the crystalline lens, onset time of SCH, hemorrhage range, treatment method, visual prognosis, and surgery-related factors including methods of operation and anesthesia. In all cases vision was assessed using a Snellen chart and was converted to the logarithm of the minimum angle of resolution (LogMAR) VA for computational purposes. The following LogMAR cutoffs were used for non-numeric VA [9]: able to count fingers (CF) = 1.7 LogMAR; able to detect hand movement (HM) = 2.0 LogMAR; light perception (LP) = 2.3 LogMAR; no light perception (NLP) = 3.0 LogMAR.

Method

Patients were retrospectively analyzed and divided into those who had SCH related to first PPV (Group 1), or SCH related to second intraocular surgery in vitrectomized eyes (Group 2). Cases were further divided into ESCH group and DSCH group, according to the onset time. The general data of SCH, related risk factors and visual prognosis in the different groups were analyzed.

Statistical analysis

Data was analyzed using SPSS17.0 software, with measurement data expressed as means±SD. A Chi-squared test was used for enumeration of the data. Independent-samples student t-test and One-Way ANOVA were used for data analysis. Pearson correlation analysis was used to analyze whether there was a correlation between vision outcome after treatment and age, axial length, and baseline vision. Data was considered statistically significant when $P<0.05$.

Results

General patient data

SCH associated with PPV was studied in 28 cases, 16 male and 12 female, with a mean age of (53.51 ± 10.21) years old and mean follow-up time of (24.94 ± 14.60) days. Among them, 10 cases had other medical conditions, 1 had a medical history of anticoagulant drug use, and 21 had high myopia with mean axial length of (28.21 ± 3.14) mm. With regards to the state of crystalline lens, 3 had phakic eyes, 9 aphakic eyes, and 16 pseudophakic eyes. (See Table 1 for more details).

Table 1
General data of SCH associated with PPV

Total number of eyes (n)	**28**
Total number of patients (n)	28
Male: Female	16:12
Mean age (y)	53.51 ± 10.21
Follow-up time (d)	24.94 ± 14.60
Anticoagulant drug use	1: 27
High myopia	21: 7
Mean axial length (mm)	28.21 ± 3.14
State of crystalline lens	
Phakic eyes	3
Aphakic eyes	9
Pseudophakic eyes	16
local anesthesia: general anesthesia	24: 4
ESCH: DSCH	24: 4
Focal SCH: Diffuse SCH	7: 21

Pathogeny of PPV-related SCH

Of those patients studied, 8 showed SCH related to first PPV, and 20 related to second intraocular surgery in vitrectomized eyes (71.43%). Among them, silicone oil removal had the highest occurrence of SCH, with 12 cases (43%), 7 cases occurred during the first PPV (25%), 3 during IOL suspension after PPV, 1 during IOL removal after PPV, 1 during cataract surgery after PPV, 1 after first PPV, 2 in post cataract surgery after PPV, 1 in post glaucoma surgery after PPV (See pie chart Fig. 1).

Comparison of SCH between first PPV group and second intraocular surgery in vitrectomized eyes group (See Table 2 **for more details).**

Table 2
Comparison of SCH between first PPV group and second intraocular surgery in vitrectomized eyes group

	SCH related to first PPV group (8 cases)	SCH related to second intraocular surgery in vitrectomized eyes group (20 cases)	P value
Male: Female	2: 6	13: 7	0.096
Age (y)	61.88 ± 8.71	50.55 ± 8.90	0.008
Mean axial length (mm)	27.70 ± 3.47	28.09 ± 3.15	0.786
Hemorrhage range (focal: diffuse)	2: 6	5: 15	0.096
Hemoorhage duration (ESCH: DSCH)	7: 1	17: 3	1.000
Baseline VA	1.73 ± 0.59	1.74 ± 0.64	0.968
Final VA	1.48 ± 0.83	1.97 ± 0.74	0.174

Eight patients were found in Group 1, with 2 males and 6 females, with a mean age of (61.88 ± 8.71) years and a mean axial length of (27.70 ± 3.47) mm. Twenty cases were found in Group 2, with 13 males and 7 females, a mean age of (50.55 ± 8.90) years and a mean axial length of (28.09 ± 3.15) mm. A Chi-squared test was applied for gender on both groups, with P = 0.096, therefore showing no statistical significance. Independent-samples T test was used for age, with P = 0.008, showing statistical significance. The latter was also applied in the analysis of axial length, with P = 0.786, showing no statistical significance. The baseline vision was 1.73 ± 0.59 in Group 1 and 1.74 ± 0.64 in Group 2, with P = 0.968 using independent sample T test. The final vision was 1.48 ± 0.83 in Group 1 and 1.97 ± 0.74 in Group 2, with P = 0.174, showing no statistical significance.

There were 2 cases of focal hemorrhage and 6 cases of diffuse hemorrhage in Group 1, while 5 focal and 15 diffuse hemorrhages in Group 2, with a Chi-squared test indicating that there was no statistically significant difference (P = 0.096). There were 7 cases of ESCH and 1 DSCH in Group 1, while 17 ESCH and 3 DSCH in Group 2 with a Chi-squared test presenting no statistically significant difference (P = 1.00).

Comparision between ESCH and DSCH (See Table 3 **for more details).**

Table 3
Comparison of ESCH and DSCH

	ESCH group (24 cases)	DSCH (4 cases)	P value
Male: Female	12: 12	3: 1	0.600
Age (y)	54.29 ± 9.65	50.75 ± 13.94	0.654
Mean axial length (mm)	28.10 ± 3.11	27.27 ± 4.04	0.729
Hemorrhage range (focal: diffuse)	6: 18	1: 3	1.000
Baseline VA	1.73 ± 0.55	1.78 ± 1.04	0.927
Final VA	1.85 ± 0.77	1.71 ± 1.00	0.792

With regards to PPV-related cases the incidence rate for ESCH was significantly greater (24 patients, 85.71%) than for DSCH (4 patients, 14.29%). Among ESCH group, 12 were male and 12 female, with a mean age of (54.29 ± 9.65) years, and a mean axial length of (28.10 ± 3.11) mm. This compares to DSCH group in which 3 were male and 1 female, with a mean age of (50.75 ± 13.94) years and a mean axial length of (27.27 ± 4.04) mm. Gender in both groups was analyzed using Chi-squared test ($P = 0.60$) and age was analyzed by an independent sample T test ($P = 0.654$) which showed no statistically significant difference. The baseline vision was 1.73 ± 0.55 in ESCH group and 1.78 ± 1.04 in DSCH group, the final vision outcome was 1.85 ± 0.77 in ESCH group and 1.71 ± 1.00 in DSCH group. This was shown no statistically significant difference using an independent sample T test ($P = 0.927$ and $P = 0.792$).

There were 6 cases of focal and 18 diffuse hemorrhages in ESCH group, compared with 1 focal and 3 diffuse hemorrhages in DSCH group. A Chi-squared test indicated that there was no statistically significant difference ($P = 1.00$).

Analysis of treatment in SCH, vision outcome and vision-related factors

With regards to SCH, 5 patients were simply observed, 4 were given single suprachoroidal drainage, 15 were given suprachoroidal drainage combining silicone tamponade, 2 underwent anterior chamber puncture, and 2 abandoned treatment. One patient underwent a single suprachoroidal drainage, and was injected with rt-PA (recombinant tissue plasminogen activator, rt-PA) in the suprachoroidal space on the 4th day after the occurrence of DSCH and drained after 4 hours (see Case 2 for further details). Patients were followed-up and the final corrected vision was seen to be: NLP ~ 20/30; among them, 2 eyes showed NLP (7.14%), 16 could detect HM to LP, 4 could CF ~ 20/400, and 6 of index ≥ 20/200 (21.43%) (See Table 4 for details). The final vision could be seen to be significantly positively correlated with baseline vision ($r = 0.545$, $P = 0.000$), but not significantly correlated with age ($r=-0.113$, $P = 0.427$) or axial length ($r = 0.073$, $P = 0.611$).

Table 4
Analysis of treatment in SCH, vision outcome

Treatment in SCH	**Number**
Observe	5
Suprachoroidal drainage	4
Suprachoroidal drainage combining silicone tamponade	15
Anterior chamber puncture	2
Abandon	2
Visual outcome	Number
NLP	2(7.14%)
LP ~ HM	16(57.14%)
CF ~ 20/400	4(14.28%)
≧ 20/200	6(21.43%)

In depth analysis of two specific cases of SCH

Case 1

patient is a 57y male, with past medical history of hypertension, heart disease, heart stenting, and oral anticoagulant drug treatment (Warfarin was stopped 5 days before surgery and replaced by low-molecular-weight Heparin Sodium Injection). The patient was given PPV combing IOL removal under general anesthesia due to IOL dislocating to vitreous space. During PPV, ESCH happened which was diffuse SCH and was observed with medication. After 4 months, the patient’s vision was 20/30 with a flat fundus (Fig. 2).

Case 2

patient is a 46y male who had swelling pain in the right eye for 3 hours after the second IOL ciliary sulcus implantation in a vitrectomized eye. The patient had previously received PPV and foreign body removal from the right eye 2 months before. The vision was LP and an intraocular pressure was 41 mmHg, and diffuse SCH involving the posterior pole with local retinal detachment, but no retinal hole. Kissing sign can be found in ultrasound examination. As no significant change occurred after 4 days, the patient was given a rt-PA injection in the suprachoroidal space and single suprachoroidal drainage was performed. Three days after drainage, the patient’s vision was 20/60, intraocular pressure 8 mmHg, and a bulge only seen in the upper choroid. Reexamination was carried out two months after surgery and the patient’s vision was 20/30 and both the fundus retina and choroid were flat (Fig. 3).

Discussion

SCH, defined as the accumulation of blood in the suprachoroidal space between the choroid and sclera, is a rare but severe complication during or after intraocular surgery that seriously threatens vision. The condition causes continuous retinal detachment, secondary glaucoma or hypotony, leading to a prognosis of poor vision, and even vision loss and eyeball atrophy. The mechanism of SCH remains unclear. Previous research has shown that the pathophysiological process of SCH involves multiple factors, and one of the induction factors is a sudden drop in intraocular pressure. The long posterior ciliary artery is particularly fragile where it penetrates from the sclera into the suprachoroidal space and is easily ruptured; excessive low intraocular pressure causes rupture of the long or short posterior ciliary artery, resulting in SCH [1, 4, 5].

According to literature reports, the incidence rate of SCH during PPV is 0.09–4.3% [7, 8], and 0.8% [8] after PPV. The risk factors of SCH associated with PPV are mainly related to high myopia, aphakic/pseudophakic eyes, surgical treatment of retinal detachment, retinal freezing and so on [5, 8, 10, 11]. However, the morphological characteristics and visual prognosis of SCH associated with PPV have not been reported. We summarized cases from our hospital over the last 10 years for cases of SCH related to first PPV and SCH related to second intraocular surgery in vitrectomized eyes, in an attempt to analyze the related risk factors, morphological characteristics and vision prognosis.

Twenty-eight cases of SCH associated with PPV were selected in the study, with 8 cases of SCH related to first PPV and 20 related to second intraocular surgery in vitrectomized eyes (71.43%). Cases occurring silicone oil removal surgery were the greatest (12 cases; 43%). The incidence rate of SCH related to second intraocular surgery in vitrectomized eyes was higher than occurring in the first PPV surgery. We thought that in the second surgery in vitrectomized eyes, the more frequent and easy fluctuation of intraocular pressure was happened without vitreous body, particularly repeated fluid-air exchange in the silicone oil removal surgery. With regards to the age at the onset of the group of second intraocular surgery in vitrectomized eye were slightly younger than the first PPV group. In our opinion, eye factors such as repeated fluctuation of intraoperative intraocular pressure, high myopia and aphakic/pseudophakic eyes were more important factors. The incidence rate of focal suprachoroidal hemorrhage associated with PPV was 25%, and no incidence rate regarding focal suprachoroidal hemorrhage has been reported in the literature.

There were 24 cases of ESCH (85.7%), which was significantly higher than that of DSCH. Recent studies have shown that the incidence rate of DSCH after PPV to be 0.8%, which is similar to the rate of 1% during surgery [9, 12]. However, the incidence rate of DSCH is lower in our study, and it might be associated with the loss of patients who didn't visit our hospital or received treatment in the outpatient department. Additionally, of the 4 cases of DSCH, one occurred after vomiting, while the other 3 cases remained unclear in induction factors. Literature reports have demonstrated that SCH has significant correlation with advanced age, long axial, rhegmatogenous retinal detachment, extensive retina photocoagulation, oral anticoagulant drug use and postoperative vomiting [8, 12–14]. In our study, there was high myopia in 75% of cases, a mean axial length of 28.21 ± 3.14mm, aphakic and pseudophakic eyes in 89.29% of cases, a mean age of 53.51 ± 10.21years old, and only one case of oral anticoagulants.

Therefore, long axial length and aphakic/ pseudophakic eyes are absolute risk factors for SCH and associated with increased fragility of blood vessels in high myopia and choroidal effusion that is easily caused by a large vitreous space and little support in the sclera and vitreous body.

In the 28 cases of SCH associated with PPV, 5 eyes were just observed, 4 given single suprachoroidal drainage, 15 given suprachoroidal drainage combining silicone tamponade, 2 underwent anterior chamber puncture, and 2 gave up treatment. According to literature reports, for non-traumatic surgery-related SCH, 70% patients' vision was less than 20/400, 12–57% of SCH cases presented NLP, which was even as high as 86% in the end [4]. Among our cases, 7.14% presented NLP and 21.43% ≥ 20/200. The prognosis of SCH associated with PPV was relatively good. The possible reasons under our analysis are as follows: 1. In normal vitreous eyes, when SCH occurs, the high bulge of choroid would forcibly squeeze out the vitreous, causing iris and crystalline lenses to shift forwards. The fronted vitreous and ocular contents would cause traction in the retina and choroid, resulting in further expansion of the SCH and retinal detachment, whereas in vitrectomized eyes, without strong traction of the vitreous, SCH tends to be localized and retinal detachment is rare. 2. Since there is no vitreous in vitrectomized eyes, the possibility of post-operative retinal proliferation is greatly reduced, thus decreasing the occurrence of continuous retinal detachment. 3. SCH occurs in vitrectomized eyes, and the postoperative inflammatory response is usually mild; it also reduced the postoperative proliferation. 4. There is internal perfusion during PPV, which can be rapidly increased when SCH occurs, thus, ocular hypotension usually does not last for an extended period. 5. The rise of postoperative intraocular pressure is controllable because "non-vitreous fluid" can easily be discharged from the anterior chamber angle and there is no severe pupillary block all the time [15]. 6. The follow-up time is short and the assessment of long-term vision would increase the validity of the findings.

Apart from a correlation with baseline vision, the visual prognosis of SCH is also related to the form of choroidal hemorrhage. The SCH which is localized, or without macular involvement, has a better prognosis. In the case of diffuse SCH, the questions remains how to improve the prognosis as much as possible. The current accepted treatment option is to perform suprachoroidal drainage surgery approximately 2 weeks after the occurrence of hemorrhage, since the liquefaction of the blood clot at this time benefits the drainage of SCH [16]. However, even when the choroid has been reattached, it is impossible for the ocular tissue function to recover from damage caused by long term hemorrhage. Therefore, early liquefaction and removal of blood clots in the suprachoroidal space to minimize the damage has become the core treatment in SCH, which is possible with the application of t-PA. In 1998, Kwon et al. first injected t-PA into the suprachoroidal space to treat SCH in animal experiments, and subsequently, there have been cases reported since 2012 [17–21]. In our study, one patient developed DSCH after a second IOL implantation in vitrectomized eyes (Case 2 above). On the 4th day after SCH, rt-PA (Alteplase, 10 μg/0.1mL) was injected into the suprachoroidal space, where drainage was performed afterward. This improved the patient's vision from LP to 20/30 which significantly improved the prognosis. Therefore, for diffuse SCH, we need to use aggressive treatment to further improve the prognosis.

There are, however, a number of shortcomings in this study: 1. The effects of intraoperative surgery were not counted, such as intraocular photocoagulation and retinal freezing; 2. The follow-up time was short and long-term visual prognosis was not analyzed; 3. The overall incidence rate of SCH associated with first PPV and with second intraocular surgery in vitrectomized eyes was not calculated; 4. The treatment methods such as t-PA treatment were not summarized because the cases of SCH were low. Therefore, sample numbers should be increased for analysis to reach a definite conclusion.

In conclusion, the incidence rate of SCH associated with second intraocular surgery in vitrectomized eyes is higher, which is related to the lack of vitreous support and caused by easier fluctuation of intraocular pressure. SCH associated with PPV is more likely to be localized, which has a relatively good prognosis. High myopia and aphakic/pseudophakic eyes remain the highest factors for SCH. Adequate preoperative assessment of patient's general conditions should be performed, and intraoperative surgery should be careful to avoid fluctuation in intraocular pressure, especially for patients who underwent second intraocular surgery in vitrectomized eyes. Furthermore, attention should be paid to risk prevention; the incision closure should be made carefully in order to reduce the risk of wound leakage, and any side-effects of anesthesia should be treated promptly and aggressively once it occurs to save the patient's vision.

Abbreviations

SCH: Suprachoroidal hemorrhage; ESCH: expulsive suprachoroidal hemorrhage; DSCH: delayed suprachoroidal hemorrhage; PPV: pars plana vitrectomy; LogMAR: Logarithm of the minimum angle of resolution; rt-PA: recombinant tissue plasminogen activator.

Declarations

Availability of data and materials

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

Authors’ contributions

BM, SFL, XYS analyzed and interpreted the patient data. BM was major contributors in writing the manuscript. YL, JZ, SLW, XYS were experienced surgeons to treat included SCH patients. SFL and XYS were critical revision of the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

The study was approved by the Ethical Committee of the Beijing Tongren Hospital. Due to the retrospective nature of this study, the inform consent from individual patient was waived by the Ethical Committee of the Beijing Tongren Hospital in this study.

Consent for publication

Written informed consent for publication of their clinical details and clinical images was obtained from the patient.

Competing interests

The authors declare that they have no competing interests.

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Figures

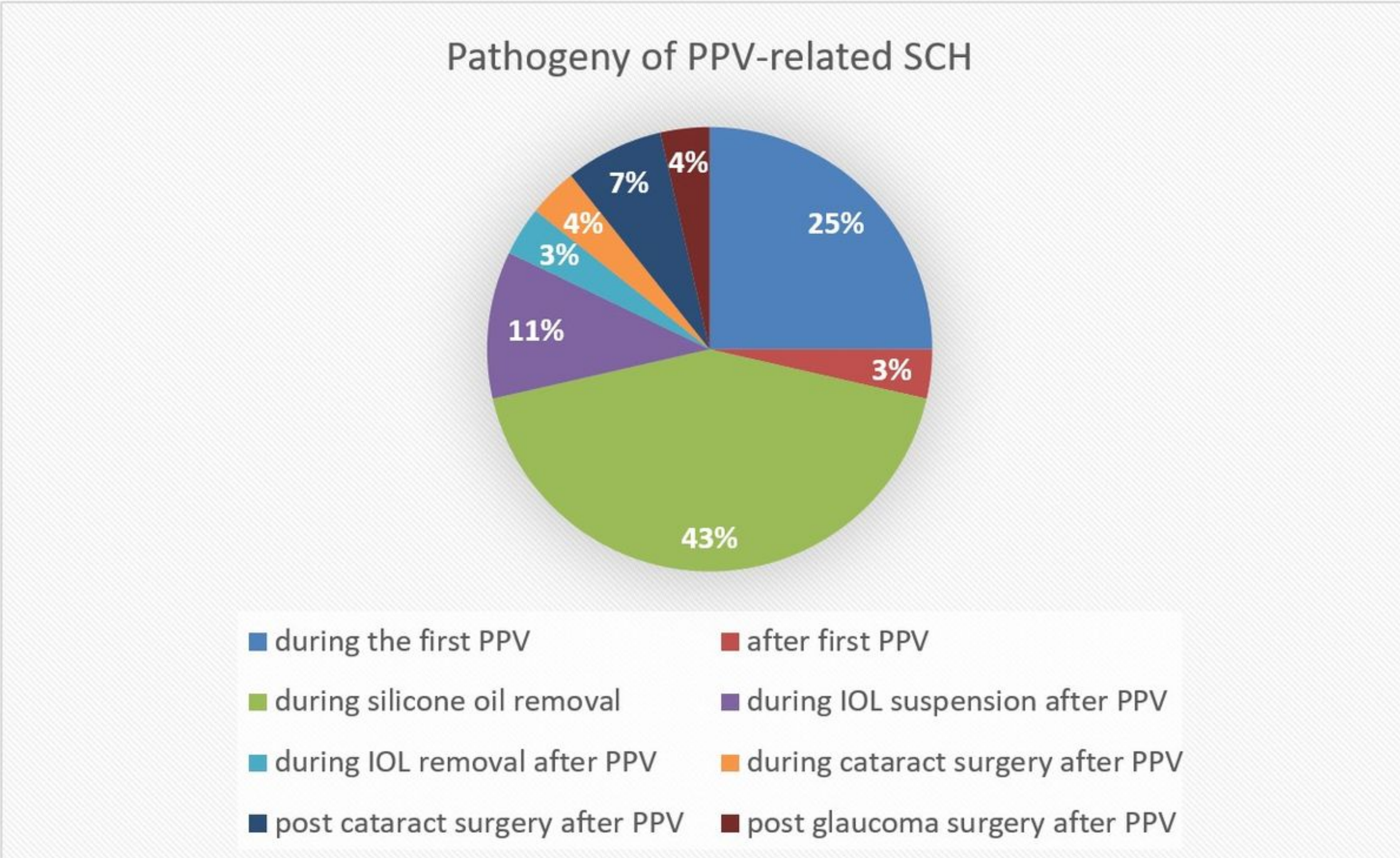

Figure 1

Pathogeny of SCH associated with PPV

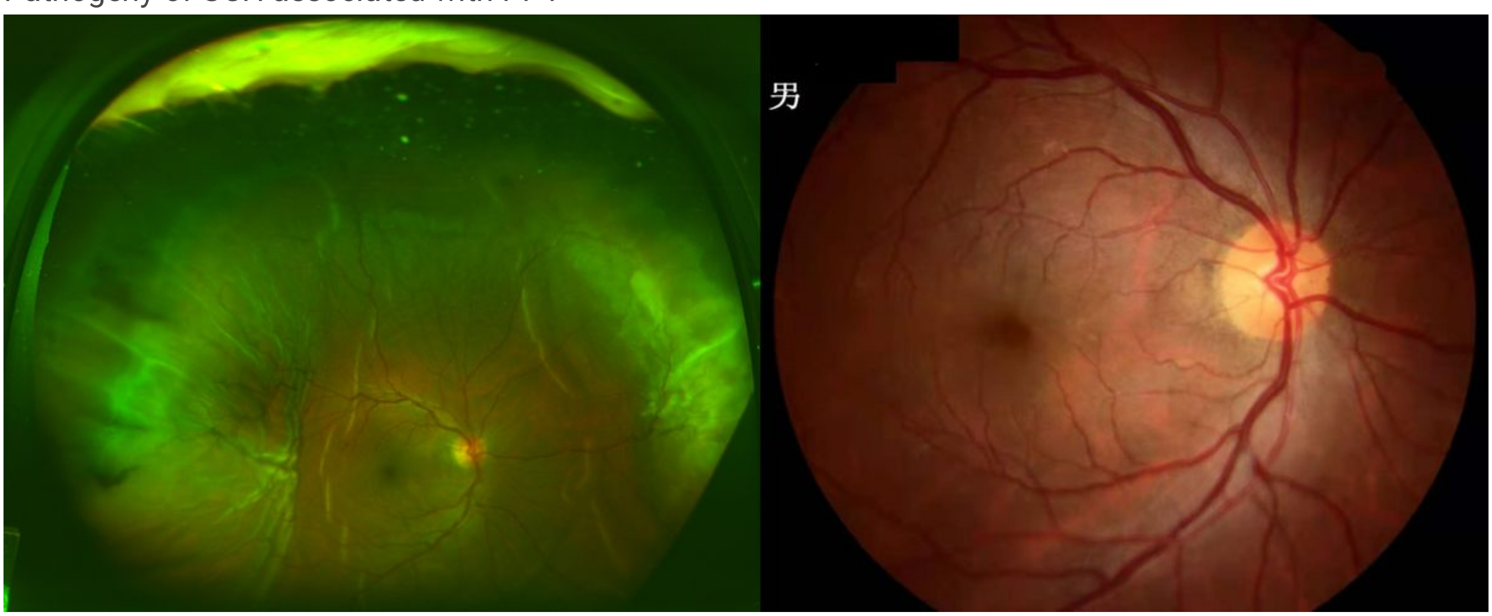

Figure 2

Fundus image of Case 1. (Left) a is a fundus image of the 5th day of ESCH; (Right) b is a fundus image of the 4th month of ESCH showed the retina was flat.

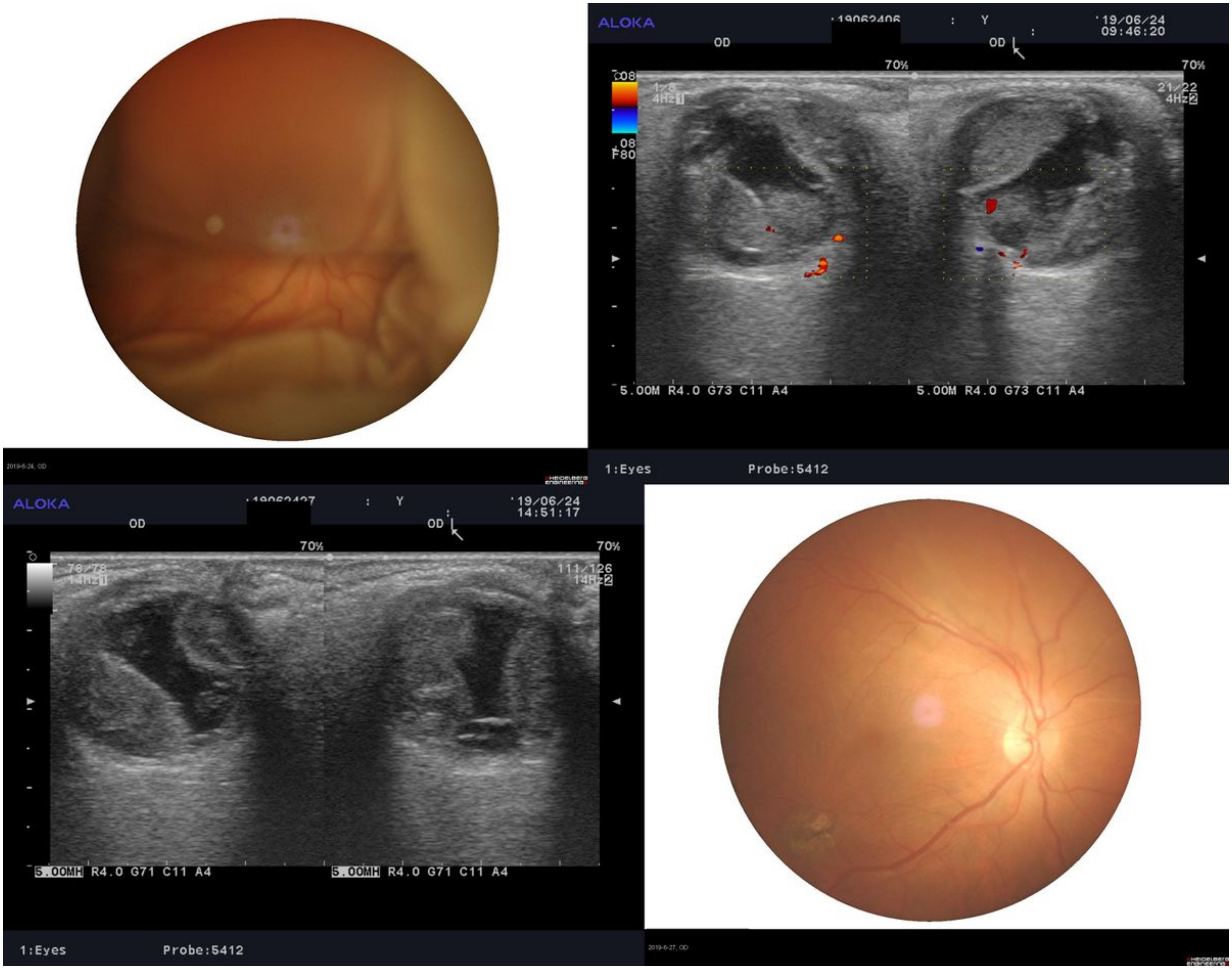

Figure 3

Fundus image and ultrasound examination of Case 2. (Top Left) a is a fundus image of the 4th day of DSCH; (Top Right) b is an ultrasound examination of the 4th day before rt-PA injection; (Bottom Left) c is an ultrasound examination showed partial liquidation of SCH on 4 hours after rt-PA injection; (Bottom Right) d is a fundus image of the 3rd day after choroidal drainage showed that a bulge only seen in the upper choroid.