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Influence of Surgical Procedures and Instruments on the Incidence of Suprachoroidal Hemorrhage during 25-gauge Pars Plana Vitrectomy

Yasuaki Iwama, MD, Hiroshi Nakashima, MD, Kazuyuki Emi, MD, PhD, Hajime Bando, MD, PhD, Toshihide Ikeda, MD

Purpose: To evaluate the influence of surgical procedures and instruments that are associated with intraocular pressure (IOP) fluctuations on the incidence of suprachoroidal hemorrhage (SCH) during 25-gauge pars plana vitrectomy (25G-PPV), and to investigate the clinical features of SCH during 25G-PPV.

Design: Retrospective, comparative case series.

Participants: A total of 3034 cases that underwent initial 25G-PPV at a single surgical center.

Methods: Univariate analysis was performed to evaluate the relationships between the incidence of SCH during 25G-PPV and the surgical procedures and instruments that were associated with IOP fluctuations. The participants were divided into 4 groups that underwent the following procedures: neither fluid-air exchange nor vitreous shaving under scleral depression (group 1, n = 1144); fluid-air exchange alone (group 2, n = 463); vitreous shaving under scleral depression alone (group 3, n = 639); and both procedures (group 4, n = 788). The incidence of SCH in each group was compared. The clinical features and surgical outcomes of SCH during 25G-PPV were also investigated.

Main Outcome Measures: The incidence of SCH during 25G-PPV and the clinical features and surgical outcomes of SCH during 25G-PPV.

Results: The incidence of SCH was significantly higher in cases that underwent fluid-air exchange ($P = 0.0047$) or vitreous shaving under scleral depression ($P = 0.0157$). There were no significant relationships between the incidence of SCH and the use of surgical instruments. The incidence of SCH in group 4 (8/788, 1.02%) was significantly higher than that in groups 1 (1/1144, 0.09%), 2 (0/463, 0%), and 3 (0/639, 0%) ($P = 0.01$). Almost all SCH cases were localized, and there were no cases of SCH involving the posterior pole. Of all the SCH cases, only one case required reoperation for retinal redetachment. No cases required secondary surgical management for SCH.

Conclusions: There remains a slight risk of SCH during 25G-PPV in cases that require both fluid-air exchange and vitreous shaving under scleral depression. Even if SCH occurs during 25G-PPV, the surgical outcomes after SCH may not be substantially worse. *Ophthalmology Retina 2018;■:1–7 © 2018 by the American Academy of Ophthalmology*

Suprachoroidal hemorrhage (SCH) is defined as bleeding in the suprachoroidal space and is reportedly associated with expulsive hemorrhage that can result in total loss of vision.[1–5] SCH during pars plana vitrectomy (PPV) presents as sudden hemorrhagic dark-brown swelling of the choroid, and although it is thought to be rare, it is still one of the potentially devastating surgical complications encountered by vitreoretinal surgeons.[6–15] Pathologic studies have indicated that ocular hypotony caused choroidal effusion with subsequent rupture of blood vessels traversing the suprachoroidal space, which include the posterior ciliary arteries.[1–3] Therefore, intraoperative hypotony is thought to be a main precipitating factor that may result in rupture of these vessels and cause SCH.[5,7,12,13]

SCH during PPV has been reported to be associated with large intraocular pressure (IOP) fluctuations during surgery.[7,8,12,14] In some experimental studies, IOP during PPV fluctuated substantially, and various surgical procedures such as fluid-air exchange and vitreous shaving under scleral depression are considered to involve potentially large IOP fluctuations.[7,8,12,16–18] Additionally, in recent years surgical instruments that prevent intraoperative hypotony and IOP fluctuations have also been improved (i.e., the Edgeplus valved trocar cannulas [Alcon Laboratories, Inc, Fort Worth, TX] and the IOP control function of the Constellation Vision System [Alcon Laboratories, Inc]). Recent reports indicate that both can attenuate IOP fluctuations during PPV and may prevent the occurrence of intraoperative SCH.[18–20]

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Therefore, it is important to evaluate the influence of the above-mentioned surgical procedures and these recent improvements in surgical instruments on the incidence of SCH during PPV.

In the current decade, the development of microincision vitrectomy surgery (MIVS) resulted in less surgical damage to the eye, less ocular inflammation, and less surgical time compared with conventional 20-gauge PPV (20G-PPV).[21–23] In addition, a wide-angle viewing system has contributed to expanding the indications for MIVS.[24] As a result, the conventional 20G-PPV system—formerly the main operative method for retinal diseases—has been largely replaced by MIVS using small-gauge (23-gauge, 25-gauge, and 27-gauge) systems.[21,25–27] Although the recent shift to smaller-gauge surgery may lead to differences in the incidence and clinical features of SCH during PPV, the literature on SCH during MIVS is very scant and there have been no reports on the incidence and clinical features of SCH during 25-gauge PPV (25G-PPV).[28–30] The main purpose of this study was to evaluate the influence of surgical procedures that cause IOP fluctuations (vitreous shaving under scleral depression and fluid-air exchange) and surgical instruments that prevent intraoperative IOP fluctuations (Edgeplus valved trocar cannulas and the IOP control function of the Constellation Vision System) on the incidence of SCH during 25G-PPV. A secondary objective was to evaluate the clinical features and surgical outcomes of SCH during 25G-PPV.

Methods

In this study, we retrospectively investigated cases that underwent initial PPV at Osaka Rosai Hospital in Japan between July 2011 and June 2014. All investigations were performed in accordance with the tenets of the Declaration of Helsinki. Institutional review board/ethics committee approval was obtained from Osaka Rosai Hospital, and informed consent was obtained from all patients before any measurements were taken. The inclusion criteria were having undergone 25G-PPV using the Constellation Vision System, wide-angle viewing system, and Edgeplus trocar cannulas. We also included patients who had undergone the triple procedure of PPV, phacoemulsification, and intraocular lens implantation all performed during the same operating session. No cases required scleral buckling or cryotherapy at the time of 25G-PPV.

Exclusion Criteria

The exclusion criteria were proliferative vitreoretinopathy (PVR), endophthalmitis, ocular trauma, and cases requiring intraocular lens removal during 25G-PPV. We excluded PVR and endophthalmitis because intraocular inflammation reportedly causes necrosis of choroidal vessels with subsequent rupture and would increase the risk of SCH.[12,28,31] We excluded ocular trauma because the incidence of SCH during PPV in traumatized eyes is reported to be substantially higher than that in other diseases.[11,12] It is also known that ocular trauma is frequently associated with several forms of structural damage, such as ocular perforation and even existing SCH.[11] We excluded cases requiring intraocular lens removal because that procedure requires a large incision, which causes prolonged hypotony during the operation and is no longer MIVS. Thus, the exclusion criteria enabled us to evaluate the incidence of SCH during 25G-PPV for common retinal diseases.

Data Collection

At our institute, all intraoperative complications were recorded in the operation notes by surgeons immediately after the operations. Therefore, all incidences of intraoperative SCH were recorded. Diagnosis of SCH was made via direct observation of the hematoma during surgery. The intraoperative blood pressure was also recorded in the operation notes, and nicardipine hydrochloride was administered if the pressure was >180/90 mmHg. The patient records of eyes with SCH were reviewed, and the patient's age, sex, triple procedures (yes or no), postoperative diagnosis of PPV, time when SCH was first noted during the procedure, extent of SCH (localized or multiple), axial length, complications of high myopia (yes or no), clinically diagnosed glaucoma (yes or no), medication history, preoperative best-corrected visual acuity (BCVA), final BCVA, preoperative IOP, final IOP, reoperation (yes or no), follow-up duration, and information about their surgical procedures and instruments were collated. Complications of high myopia included posterior staphyloma, chorioretinal atrophy, myopic foveoschisis, and a history of myopic choroidal neovascularization.[32] In addition to the operation notes, in cases for which video recordings were available they were reviewed by 3 investigators (Y.I., H.N., K.E.) to confirm the time when SCH was first noted during the procedure and the extent of SCH.

Clinical Evaluation

All patients treated with 25G-PPV underwent a comprehensive ophthalmologic examination, including measurement of BCVA and IOP, slit-lamp examination, ophthalmoscopy, and fundus photography at their preoperative visit; at 1, 3, and 6 months after surgery; and as needed thereafter. When ophthalmoscopy was not possible (mainly due to mature cataract or vitreous hemorrhage), we used B-mode scan images to make a preoperative diagnosis. The results of these preoperative and postoperative clinical evaluations were recorded in the patient records.

Study Design

First, univariate analysis was performed to evaluate the relationships between the incidence of SCH during 25G-PPV and the surgical procedures and instruments associated with IOP fluctuations. Based on the univariate analysis results, we divided the participants into 4 groups depending on the surgical procedure performed ($P < 0.05$ in univariate analysis): neither fluid-air exchange nor vitreous shaving under scleral depression (group 1, n = 1144); fluid-air exchange alone (group 2, n = 463); vitreous shaving under scleral depression alone (group 3, n = 639); and both procedures (group 4, n = 788). The incidence of SCH in each group was compared. We also investigated the clinical features and surgical outcomes of SCH during 25G-PPV, including the time when SCH was first noted, extent of SCH, postoperative diagnosis, and reoperation cases that entailed secondary surgical management for SCH.

Statistical Analysis

The study data were analyzed using JMP Pro software for Windows (version 13.0; SAS Inc, Cary, NC). All values are presented as means ± standard deviations. BCVA values were converted to logarithm of the minimum angle of resolution equivalents for analysis. Preoperative and postoperative BCVA values were compared using the Wilcoxon signed-rank test. Univariate analysis of the associations between the incidence of SCH and each categorical variable was performed using Fisher exact test. Factors that were significant at the $P < 0.05$ level in the univariate analysis were included in the subsequent analysis. Comparisons of the