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RETINAL DISORDERS

Anatomical findings of vitreoretinal interface in eyes with asteroid hyalosis

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Abstract
Purpose To investigate the anatomical features of vitreoretinal interface in eyes with asteroid hyalosis (AH) with optical coherence tomography (OCT) and intravitreal triamcinolone acetonide (TA) during vitreous surgery.
Methods This study was an interventional clinical case series. Records relating to ten eyes from ten patients who underwent a TA-assisted vitrectomy for the treatment of diverse vitreoretinal diseases complicated with AH. The posterior vitreoretinal interface was examined by preoperative OCT and by intraoperative visualization of posterior vitreous cortex utilizing TA.
Results In eight of ten AH eyes, preoperative OCT revealed abnormal vitreoretinal adhesions. In four of these eight eyes, posterior vitreoschisis could be seen on OCT. In the other four of these eight eyes, a clear no posterior vitreous detachment (PVD) pattern could be seen on OCT. Although posterior vitreous cortex could not be clearly identified with preoperative OCT in two of ten AH eyes, a complete PVD was refuted by intraoperative visualization of the posterior vitreous cortex with TA identical to the other eight eyes.
Conclusion These results indicate that complete PVD appears to be unlikely to occur in eyes with AH. In addition, spontaneous PVD in eyes with AH might lead to vitreoschisis or residual whole layer or posterior vitreous cortex, possibly due to anomalous vitreoretinal adhesion.

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Introduction

The vitreous in eyes with asteroid hyalosis (AH) has unique characteristics such as reduced gel liquefaction and anomalous vitreoretinal adhesion [1]. Anomalous vitreoretinal adhesion may lead to the formation of a residual vitreous cortex (VC) on the retina under normal physiological conditions and during vitreous surgery [2, 3]. Anomalous vitreoretinal adhesion also causes anomalous posterior vitreous detachment (PVD), occasionally associated with vitreoschisis. Previous reports proposed definition of vitreoschisis as a split between an inner and an outer layer of the vitrous cortex [3, 4]. Anomalous PVD may be associated with vitreoretinal interface disorders such as an epiretinal membrane or a macular hole [2, 5, 6]. The posterior vitreous cortex is supposed to be a component of the epiretinal membrane, at least in part [7]. We previously investigated the excised internal limiting membrane (ILM) in an eye with AH, and reported anomalous vitreoretinal adhesion by transmission electron microscopy (TEM) [8]. In this study, we recruited a larger number of AH cases to evaluate the clinical and anatomical characteristics of the vitreoretinal interface in eyes with AH, using preoperative optical coherence tomography (OCT) and intraoperative triamcinolone acetonide (TA).

Subjects and methods

This study was an interventional clinical case series, and was approved by the Institutional Review Board and

performed in accordance with the ethical standards of the 1989 Declaration of Helsinki. Written informed consents were obtained from all patients enrolled in this study. The clinical characteristics of the ten eyes included in this study are summarized in Table 1. From April 2004 to April 2008, ten eyes from ten patients undergoing TA-assisted vitrectomy for AH with diverse vitreoretinal diseases were selected for this study. TA-assisted vitrectomies were performed at Kyushu University Hospital by three surgeons. The patients' ages ranged from 48 to 85 years, with a mean age of 71.5±10.7 years. The condition of each eye was monitored for at least 6 months following surgery. All patients received ophthalmologic examinations including best-corrected visual acuity (BCVA), slit-lamp biomicroscopy and OCT. The vitreoretinal interface in eyes with AH was preoperatively evaluated using a time-domain OCT (Stratus OCT, MODEL 3000, Carl Zeiss Meditec, Dublin, CA, USA) or a spectral-domain OCT (Cirrus HD-OCT, MODEL 4000, Carl Zeiss Meditec) and intra-operatively by an intravitreal injection with TA in all eyes.

Results

We classified the eyes into those where we observed an inner and outer layer of posterior vitreous cortex with preoperative OCT and those where we observed a Weiss ring as well as posterior vitreous cortex on the retinal surface with preoperative OCT as «vitreoschisis patterns». We used the definition by Sebag that vitreoschisis is splits in the posterior vitreous cortex [4]. On the other hand, eyes where no Weiss ring was observed but where the posterior vitreous cortex on the retinal surface with preoperative OCT was observed were classified as «no PVD patterns». Although we also defined as «complete PVD pattern» those without the posterior vitreous cortex on the retina after intraoperative visualization with TA, in fact complete PVD was not observed in any of the cases. Preoperative OCT revealed abnormal vitreoretinal adhesions in eight of ten AH eyes. Although the posterior vitreous cortex could not be clearly identified with preoperative OCT in two out of ten AH eyes, a complete PVD was refuted by intraoperative visualization of a posterior vitreous cortex with TA identical to the other eight eyes. Preoperative OCT revealed a posterior vitreoschisis pattern (four of the eight eyes) and no PVD pattern (four of the eight eyes) in the vitreoretinal interface of AH eyes. The details are as follows: of four eyes in the posterior vitreoschisis pattern, two eyes had a Weiss ring at slit-lamp biomicroscopy. However, a posterior VC on the retina was detected by OCT (case 8, Fig. 1). Two eyes had a partial vitreoschisis: in one of the two eyes, the inner layer of the split vitreous cortex appeared detached

Table 1 Clinical characteristics of ten eyes

Case	Age (years), gender, eye	Diagnosis	Indication for surgery	Weiss ring	Preoperativevitreoretinal adhesions	Pre-operative vitreoschisis	Intraoperative vitreoretinal adhesions	Visual Acuity Pre-op Post-op	Follow-up (months)
1	85/M/R	MH	Macular hole (stage III)	−	?	−	+	20/100 20/50	25
2	72/M/L	RRD	RRD	−	+	−	+	20/66 20/50	19
3	75/F/R	PrePDR	ME	−	?	−	+	20/200 20/100	13
4	69/M/L	PDR	TRD	−	+	+	+	20/400 20/300	15
5	48/F/L	RP	Decreased VA	−	+	−	+	20/66 20/25	15
6	63/F/R	MH	Macular hole (stage IV)	+	+	+	+	20/50 20/25	14
7	75/M/L	BRVO	ME	−	+	−	+	20/50 20/20	11
8	76/F/L	ERM	PM	+	+	+	+	20/50 20/25	10
9	68/F/R	MA	SRH	−	+	−	+	20/2000 20/100	8
10	84/M/L	SDR	ME	−	+	+	+	20/50 20/40	6

M, male; F, female; R, right; L, left; MH, macular hole; RRD, rhegmatogenous retinal detachment; PDR, proliferative diabetic retinopathy; RP, retinitis pigmentosa; BRVO, branch retinal vein occlusion; ERM, epiretinal membrane; MA, retinal macroaneurysm; SDR, simple diabetic retinopathy; ME, macular edema; TRD, tractional retinal detachment; VA, visual acuity; PM, premacular membrane; SRH, subretinal hemorrhage

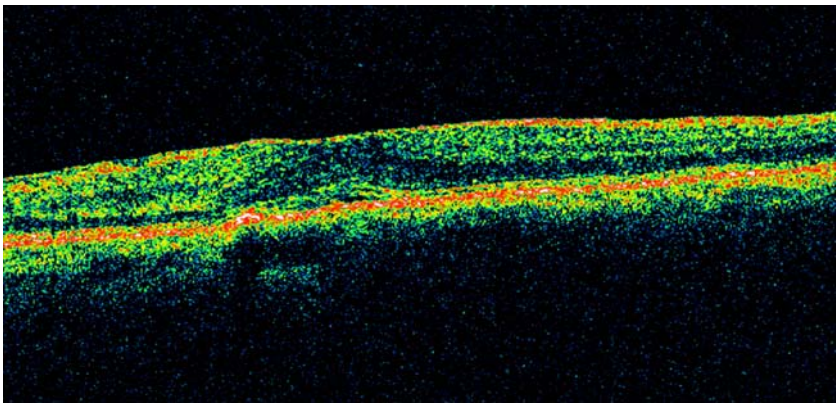

Fig. 1 Preoperative images of an eye with epiretinal membrane (case 8). Preoperative optical coherence tomography (OCT; Stratus OCT, MODEL 3000) images of residual vitreous cortex exerting horizontal traction on the foveal center. OCT shows thickening of the fovea

except for a vitreo-disc adhesion. The outer layer of the split vitreous cortex appeared remaining on the retina (case 4, Fig. 2a,b). In the other one, the inner layer of the split vitreous cortex appeared detached from the optic disc, but remained topically attached to the macular area. The outer layer of the split vitreous cortex appeared to remain on the retina (case 10, Fig. 3). whereas four eyes of the «no PVD pattern» showed vitreoretinal adhesions on OCT examination (Case 9, Fig. 4).

The postoperative follow-up period ranged from 6 to 25 months, with a mean follow-up period of 13.6 (SD 5.5) months. The mean postoperative BCVA significantly improved from 0.74 (logMAR units; SD 0.55) to 0.43 (logMAR units; SD 0.37) ($P<0.01$). Iatrogenic retinal

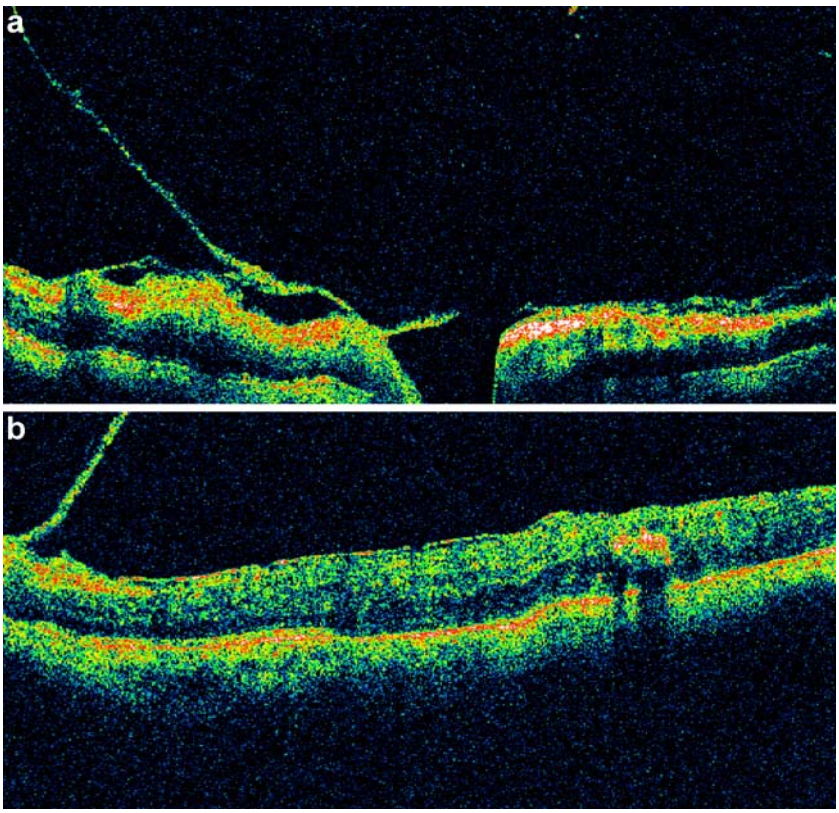

Fig. 2 Preoperative OCT (Stratus OCT, MODEL 3000) images of an eye with proliferative diabetic retinopathy (Case 4). **a** Horizontal direction OCT shows posterior vitreoschisis on the nasal retina and vitreo-disc adhesion on the optic disc. **b** Horizontal direction OCT reveals vitreo-retinal adhesion on the temporal retina and vitreo-disc adhesion on the optic disc

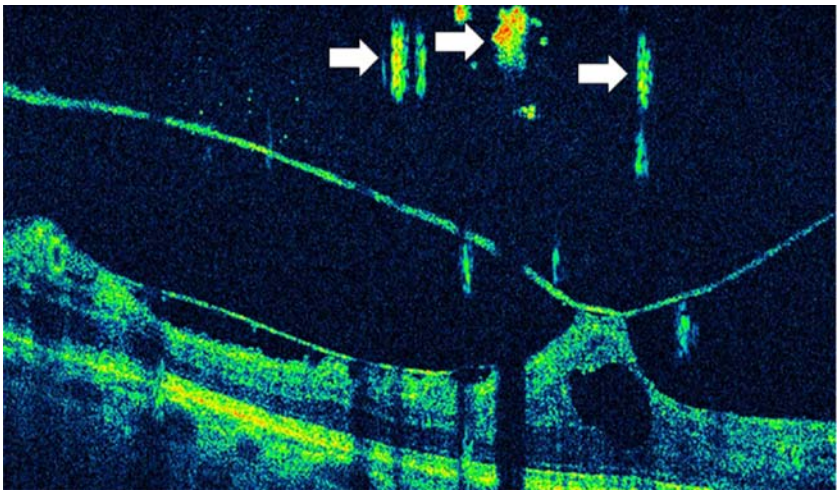

Fig. 3 Preoperative OCT (Cirrus HD-OCT, MODEL 4000) images of an eye with diabetic macular edema (case 10). Horizontal direction OCT shows posterior vitreoschisis and vitreo-macula traction on the post pole. *Arrows* indicate the asteroid bodies in the vitreous cavity

breaks occurred, and they were successfully treated in one eye that had proliferative diabetic retinopathy. In two out of ten eyes, a temporary intraocular pressure elevation was observed. However, it did not last longer than 1 week in any of the eyes.

Discussion

There have been numerous reports concerning the ultrastructure and composition of asteroid bodies [9, 10], but the pathophysiology of the vitreoretinal interfaces in eyes with AH is not fully understood to date. Previous studies have reported that the percentage of complete PVD was 24–38% in eyes with AH [1, 11]. In these reports, the presence of PVD was evaluated by slit-lamp biomicroscopy. The appearance of a Weiss ring was also defined as a complete PVD [12]. However, it is difficult to examine the presence of complete PVD by using the conventional method, especially in cases of AH, because the accumulation of asteroid bodies sometimes become so dense as to prevent accurate examination of the fundus. By contrast, previous studies have reported its usefulness under such limited conditions [13, 14]. OCT enabled clear detection of the residual VC on the retinal surface in most of the AH eyes. Furthermore, it was verified with OCT in the present report that in some cases posterior VC remained on the retinal surface even if the Weiss ring was present. These results indicate that the actual percentage of complete PVD in AH might be lower than the percentage reported previously [1, 11]. As with the two eyes in this study, however, the posterior vitreous cortex sometimes can not be clearly identified with preoperative OCT. Regardless of the presence or absence of AH, it may sometimes be difficult to visualize the posterior vitreous cortex under OCT, especially in eyes with severe cataract or poor mydriasis.

We present a case series demonstrating some different appearances seen on OCT examination in the spontaneous

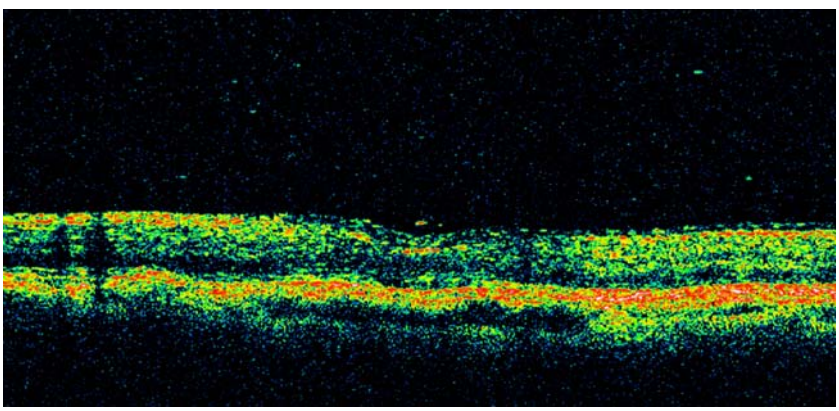

Fig. 4 Preoperative OCT (Stratus OCT, MODEL 3000) images of an eye with retinal arteriolar macroaneurysm (case 9). Horizontal direction OCT shows a posterior vitreous cortex on the retina

PVD formation in AH eyes. In case 4 of our series, the OCT appearance represents vitreo-disc traction. If spontaneous release of the vitreo-disc traction was created, it is likely that a Weiss ring would be observed, as in cases 6 and 8. Anomalous vitreoretinal adhesion may lead to a residual VC on the retinal surface in the process of spontaneous PVD formations in AH eyes. In case 8, preoperative slit-lamp biomicroscopy revealed a premacular membrane and a Weiss ring. We diagnosed clinically the eye with an epiretinal membrane. However, we examined previously the histology of the vitreoretinal interface in an AH eye using TEM, which revealed a massive posterior VC with few cellular components on the excised ILM [8]. The outer layer of the posterior VC remaining on the retina could be visible as an epiretinal membrane. The VC left on the retina can act as a scaffold for cellular proliferation, which could be a source of postoperative vitreoretinal interface disorders. Ikeda et al. reported that the surgical technique is difficult in cases of proliferative diabetic retinopathy complicated with AH, because of reduced gel liquefaction and abnormal vitreoretinal adhesion [15]. As a result, they described that the residual VC might postoperatively cause retinal redetachment due to tangential traction. Yamaguchi et al. also performed a TA-assisted vitrectomy for all AH eyes and reported on anomalous vitreoretinal adhesions in the eyes with AH [16].

The results of our study suggest that AH eyes may often have a high ratio of firm vitreoretinal adhesion. Spontaneous PVD in AH might lead to anomalous PVD occasionally associated with vitreoschisis, possibly due to anomalous vitreoretinal adhesion. However, the diverse vitreoretinal diseases present in this study can, irrespective of the presence of AH, on their own be complicated by abnormal vitreoretinal adhesions and anomalous PVD. Furthermore, OCT was a useful instrument for investigating the vitreoretinal interface in eyes with AH, and intraoperative TA facilitated complete removal of residual VC, possibly lowering the incidence of post-operative vitreoretinal interface disorders, although longer follow-up is necessary.

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References

1. Wasano T, Hirokawa H, Tagawa H, Trempe CL, Buzney SM (1987) Asteroid hyalosis: posterior vitreous detachment and diabetic retinopathy. Ann Ophthalmol 19:255–258
2. Sebag J (2004) Anomalous posterior vitreous detachment: a unifying concept in vitreo-retinal disease. Graefes Arch Clin Exp Ophthalmol 242:690–698, doi:10.1007/s00417-004-0980-1
3. Yamashita T, Uemura A, Sakamoto T (2008) Intraoperative characteristics of the posterior vitreous cortex in patients with epiretinal membrane. Graefes Arch Clin Exp Ophthalmol 246:333–337, doi:10.1007/s00417-007-0745-8
4. Sebag J (2008) Vitreoschisis. Graefes Arch Clin Exp Ophthalmol 246:329–332, doi:10.1007/s00417-007-0743-x
5. Kishi S, Hagimura N, Shimizu K (1996) The role of the premacular liquefied pocket and premacular vitreous cortex in idiopathic macular hole development. Am J Ophthalmol 122:622–628
6. Gandorfer A, Rohleder M, Kampik A (2002) Epiretinal pathology of vitreomacular traction syndrome. Br J Ophthalmol 86:902–909, doi:10.1136/bjo.86.8.902
7. Kishi S, Shimizu K (1994) Oval defect in detached posterior hyaloid membrane in idiopathic preretinal macular fibrosis. Am J Ophthalmol 118:451–456
8. Mochizuki Y, Hata Y, Hisatomi T, Kawahara S, Arita R, Enaida H, Ueno A, Ishibashi T (2008) Posterior vitreous cortex characteristics of an eye with asteroid hyalosis. Retin Cases Brief Rep 2 (3):184–186, doi:10.1097/ICB.0b013e3180467824
9. Winkler J, Lunsdorf H (2001) Ultrastructure and composition of asteroid bodies. Invest Ophthalmol Vis Sci 42:902–907
10. Zaharopoulos P, Schnadig V (2003) Vitreous cytology in asteroid hyalosis and observations on interpretation of cytologic findings in specimens of the posterior (vitreous) compartment of the eye. Diagn Cytopathol 28:88–91, doi:10.1002/dc.10236
11. Foos RY, Wheeler NC (1982) Vitreoretinal juncture: synchysis senilis and posterior vitreous detachment. Ophthalmology 89:1502–1512
12. Takahashi M, Trempe CL, Schepens CL (1980) Biomicroscopic evaluation and photography of posterior vitreous detachment. Arch Ophthalmol 98:665–668
13. Browning DJ, Fraser CM (2004) Optical coherence tomography to detect macular edema in the presence of asteroid hyalosis. Am J Ophthalmol 137:959–961, doi:10.1016/j.ajo.2003.11.049
14. Hwang JC, Barile GR, Schiff WM, Ober MD, Smith RT, Del Priore LV, Turano MR, Chang S (2006) Optical coherence tomography in asteroid hyalosis. Retina 26:661–665, doi:10.1097/00006982-200607000-00012
15. Ikeda T, Sawa H, Koizumi K, Yasuhara T, Kinoshita S, Tano Y (1998) Vitrectomy for proliferative diabetic retinopathy with asteroid hyalosis. Retina 18:410–414, doi:10.1097/00006982-199809000-00003
16. Yamaguchi T, Inoue M, Ishida S, Shinoda K (2006) Detecting vitreomacular adhesions in eyes with asteroid hyalosis with triamcinolone acetonide. Graefes Arch Clin Exp Ophthalmol 13:1–4