황반원공을 동반한 2형 황반부 모세혈관 확장증의 수술 결과

Surgical Outcomes of Macular Telangiectasia Type 2 Associated with Macular Hole

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Purpose: To report the surgical outcomes of cavitation or full thickness macular hole (FTMH) developing in macular telangiectasia (MacTel) type 2.

Methods: This is a retrospective study of patients who underwent vitrectomy for MH or lamellar hole (LH) developed in MacTel. Patients with characteristic findings of MacTel on optical coherence tomography (OCT) and fluorescein angiography or with characteristic OCT findings in both eyes were classified as having MacTel (MacTel with FTMH: 4 eyes, MacTel with cavitation: 4 eyes) postoperative outcomes including best corrected visual acuity (BCVA) and macular configuration by OCT were reviewed.

Results: In the FTMH group, BCVA improved to more than 0.2 logMAR in 2/4 eyes and decreased in 2/4 eyes. In the cavitation-associated group, BCVA improved in 1/4 eyes, remained unchanged in 3/4 eyes, and decreased in no eyes. The FTMH was closed in 3/4 eyes, and in 4 patients with cavitation, all defect sites were recovered after surgery.

Conclusions: The surgical outcome for MacTel-associated cavitation or FTMH was worse than that of conventional LH or MH. However, it was better than that found in past reports. Thus, surgical treatment can be considered in cases of continuous visual deterioration.

Keywords: Asian; Macular hole; Retinal telangiectasia; Vitrectomy

Introduction

Retinal imaging equipment has increased understanding of macular telangiectasia (MacTel) type 2. MacTel 2 includes features of slight retinal blurring, mild enlargement of retinal capillaries, and white spots on the retina surface [1-4]. It is also characterized by the presence of right angle vessels and

subsequent proliferation of retinal pigment epithelium.

MacTel type 2 was reported to occur in approximately 1 of 1,000 people in the Beaver Dam population. It occurred mainly in middle-aged men and women but was more frequent in women [5]. Gass and Blodi [3] classified MacTel type 2 into five stages. Cystic change in the inner retinal layer is observed in 50-100% of patients with stage 3 or higher

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MacTel type 2 [6-8]. Subretinal neovascularization defines Stage 5. Yannuzzi et al. [4] classified Gass's stages 1 to 4 as non-proliferative lesions and stage 5 as proliferative lesions.

To the best of our knowledge, Patel et al. [9] was the first to report MacTel associated with lamellar hole (LH), and the association of MacTel with macular hole (MH) was reported by Olson and Mandava [10]. Thereafter, there have been several reports of MacTel with LH or MH based on optical coherence tomography (OCT) [11-14]. There have also been several papers reporting poor surgical outcomes for patients with MacTel associated with LH or MH [13-17]. However, there were several limitations in previous studies, including very small sample sizes and including only Western patients. The purpose of this study is to investigate surgical outcomes of Asian patients with MacTel-associated LH or MH.

Materials and Methods

The medical records of all patients who underwent retinal surgery for LH or MH performed by five retinal surgeons in HanGil Eye Hospital between January 1, 2009 and August

31, 2017 were retrospectively reviewed. Based on OCT (Optos OCT SLO, Optos, London, UK; Spectralis, Heidelberg Engineering, Heidelberg, Germany) and fundus photography, cases with a high probability of association with MacTel were identified. Patients who had characteristic findings of MacTel by OCT and fluorescein angiography or who had characteristic OCT findings in both eyes were classified as having MacTel. Thereafter, exclusion criteria were applied as follows: 1) presence of moderate to severe diabetic retinopathy, 2) history of any retinal surgery, 3) spherical equivalent more than ± 6 diopters (D), 4) posterior staphyloma, 5) follow-up period less than 6 months, and 6) presence of grade 3 or higher nuclear sclerosis cataract that could affect visual acuity.

Subsequently, cases were divided into two groups: 1) MacTel with cavitation and 2) MacTel with full thickness MH (FTMH) (Fig. 1, 2). Surgery was performed when the inner retinal defect increased in size and visual acuity deteriorated during the observation period of the cavitation group.

All patients underwent 23 or 25 gauge (G) pars plana vitrectomy (PPV) combined with internal limiting membrane (ILM) peeling of the major vascular arcade by retina forceps,

Figure 1. Images of macular telangiectasia with full thickness macular hole (FTMH) (case 1: A-C; case 2: D-G; case 3: H-K). (A) Telangiectatic vessels (arrows) were observed during fluorescein angiography (FAG) before surgery. (B) Full thickness macular hole (MH) with intraretinal cysts (asterisk) were observed in areas with dilated vessels in optical coherent tomography before surgery. (C) After surgery, MH was closed. (D) FAG showed more severe enhancement than case 1. (E) As in case 1, FTMH was observed. (F) After surgery, MH was initially closed. (G) In this patient, macular hole reopened after one month. (H) Case 3 had intraretinal cyst and FTMH in the left eye. (I) Twenty four months postoperatively, closed FTMH was well maintained. (J) Cavities of inner and outer retina were simultaneously observed in the right eye. (K) Four months postoperatively, FTMH closed, but visual acuity decreased from 1.0 logarithm of minimal angle of resolution (logMAR) to 1.3 logMAR.

and air or 10-14% C3F8 gas tamponade was performed. For membrane peeling, indocyanine green (ICG) staining was performed before peeling. ICG concentration was diluted to 0.5-0.05% to reduce retina toxicity. This study was approved by the hospital Institutional Review Board (IRB) and adhered to the tenets of the Declaration of Helsinki (IRB approval number: 18003).

Results

Among the 119 eyes that underwent LH surgery, 10 were suspected to be associated with MacTel by OCT. Of these 10 eyes, eight were excluded according to the exclusion criteria, and two were classified in the MacTel with cavitation group. Among 209 patients who underwent surgery for MH, 14 eyes were suspected to have MacTel by OCT. Of these 14 eyes, eight were excluded by exclusion criteria, four were considered to have MacTel with FTMH, and the remaining two were considered to have MacTel with cavitation. Finally, four eyes were classified into the MacTel with FTMH group, and four eyes were classified into the MacTel with cavitation group. None of the enrolled patients underwent surgery in both eyes.

The demographic profiles, visual acuity, follow-up period, and surgical outcomes of patients are summarized in Table 1. The mean age of patients was 64.4 years, the male to female

Figure 2. Images of macular telangiectasia with cavitation (case 5: A, B; case 6: C, D; case 7: E, F; case 8: G, H). (A) Case 5 had outer retinal cavitation and small intraretinal cyst in the left eye. (B) Three months postoperatively, retinal cavitation disappeared. (C) Case 6 also had multiple intraretinal cysts in the right eye. (D) Retinal cavitation resolved and visual acuity was stable after surgery. (E) Macular telangiectasia (arrow) was observed during fluorescein angiography. (F) Intraretinal cyst and internal limiting membrane drape were observed before surgery. Case 6 had intraretinal cavities and outer retina defect in the right eye. (G) In case 8, telangiectatic vessels (arrow) were observed during fluorescein angiography. (H) Multiple intraretinal cysts were observed in the inner retina, but damage of the outer retina was not clear.

Table 1. Demographics of the three ciliary body tumor groups

Group	Case	HTN	Age (years)	Sex	Initial CDVA	Last CDVA	F/U (months)	Surgical factor			
								FTMH size (μm)	Cat op.	FTMH/cavitation initial close	FTMH/cavitation recur
1	1	O	70	M	0.8	0.2	43	410	X	O	X
1	2	X	64	F	0.3	0.7	6	287	O	O	O
1	3	O	69	M	1.0	0.2	24	339	X	O	X
1	4	O	56	F	1.0	1.3	10	345	O	O	X
2	5	X	58	F	0.7	0.6	17	-	X	O	X
2	6	O	54	F	0.3	0.2	6	-	O	O	X
2	7	O	75	F	0.4	0.2	52	-	O	O	X
2	8	O	69	M	0.4	0.3	15	-	X	O	X

Visual acuity is LogMAR function. Group 1 is definitive macular telangiectasia (MacTel) with FTMH. Group 2 means MacTel with cavitation. HTN = hypertension; CDVA = corrected distal visual acuity; F/U = follow-up; FTMH = full thickness macular hole; Cat op. = cataract operation; M = male; F = female.

Table 2. Surgical results of previous reports in FTMH with type 2 macular telangiectasia

Reporting year	Author	Number of Patients	Surgical results				
			FTMH size (μm)	MH closed	MH not close	MH recur	Closing rate (%)
2008	Rishi and Kothari ¹⁵	1	564	0	1	0	0
2009	Charbel et al ¹⁶	2	NA	0	2	0	0
2010	Gregori and Flynn ¹⁷	2	NA	1	0	1	50
2011	Shukla ¹³	1	448	1	0	0	100
2014	Karth et al ¹⁴	4	NA	1	2	1	25
2019	Our data	4	345 (average)	3	0	1	75

FTMH = full thickness macular hole; MH = macular hole; NA = not accessible.

ratio was 3 to 5, and 75% of patients had hypertension. In the MacTel with cavitation group, the follow-up period ranged from 6 to 52 months, and the mean initial best corrected visual acuity (BCVA) was 0.45 logarithm of minimal angle of resolution (logMAR). In the MacTel with FTMH group, the follow-up period ranged from 6 to 43 months, and the mean initial BCVA was 0.78 logMAR. A change greater than 0.2 logMAR (two lines of letters) in visual acuity was regarded as clinically meaningful [18]. Preoperative FTMH size ranged from 287 to 410 μm , and the average size was 345 μm .

Visual outcomes and MH closure rate are summarized in Table 1, and Table 2 provides comparisons with previous reports. Two eyes (2/4) in the MacTel with FTMH group and one eye (1/4) in the MacTel with cavitation group showed visual improvement after surgery. Three eyes (3/4) in the MacTel with cavitation group did not show any visual acuity change. Two eyes (2/4) in the MacTel with FTMH group showed decreased visual acuity after surgery.

FTMH was closed in three eyes (3/4 eyes in the MacTel with FTMH group); four patients with cavitation, all defect sites were recovered after surgery (4/4 eyes in MacTel with cavitation group). One patient whose FTMH was not closed underwent C3F8 tamponade, and visual acuity decreased. This case was accompanied by severe MacTel; while the macular hole closed initially, it reopened after 1 month (Fig. 1, case 2). In another one case of FTMH, the MH closed after surgery, but visual acuity decreased (Fig. 1, case 4).

Discussion

Although MacTel type 2 is a common disease, its patho-

physiology is not fully understood, and a gold standard for its treatment has not yet been established. Recently, several studies reported that anti-vascular endothelial growth factor (anti-VEGF) was effective in patients with proliferative stage of MacTel type 2 [19-21]. In contrast, there are many skeptical reports on the effect of anti-VEGF for the non-proliferative phase of MacTel type 2 [21-23]. These results are likely associated with the pathophysiology of MacTel. The early developmental stage of MacTel is believed to be caused by instability of Müller cells, while vascular instability only occurs in the late neovascular stage. In other words, MacTel is thought to progress from early neurodegenerative disease to vasculodegenerative disease. Since anti-VEGF can only prevent the late vasculodegenerative stage, it can easily be assumed that anti-VEGF does not have any therapeutic effect in the early neurodegenerative stage.

Although there is no accurate data, experience has shown that MacTel is rarely accompanied by LH or MH, and most patients with MacTel suffer from continuous deterioration of vision. Accordingly, surgery is considered one treatment modality. Since the first paper on surgical outcomes for patients with MacTel and MH was published by Rishi and Kothari [15], several reports have been published on surgical outcomes for patients with MacTel [13-17]. However, the surgical results were usually unsatisfactory (Table 2). One explanation for the unsatisfactory results is that, unlike idiopathic MH, which occurs due to space formation as a result of macular traction (not due to tissue defect), MacTel associated with LH or MH is caused by Müller cell injury and a secondary tissue defect. In other words, there is no surrounding tissue to fill the hole even after surgery. However, MH associated with pathologic myopia is caused by insufficient

retinal tissue compared to the staphyloma area. Nevertheless, the anatomic closure rate after surgery is approximately 80% [24,25]. While these two diseases cannot be directly compared, the success rate of previous reports for MacTel with MH is unusually low compared to cases of pathologic myopia.

Previous reports on MacTel with MH only considered Western patients and comprised fewer than eight patients [13-17]. However, there are no available data about surgical outcomes of Asian patients with MacTel and MH. Of the eight Asian patients included in our study, MH closed in 3 of 4 FTMH patients, and retinal cavitation resolved after surgery in all patients of the cavitation group. These results are similar to those of typical idiopathic FTMH or MH with high myopia and are overall more positive than results of previous reports [13-17]. In the cavitation group, VA improved in 1/4 eyes and remained unchanged in 3/4 eyes. In the FTMH group, VA improved in 2/4 eyes and decreased in 2/4 eyes. These results suggest that surgical treatment for cavitation or FTMH with MacTel may help to maintain visual acuity. Therefore, surgery may be a treatment method worth considering as there is currently no other alternative.

It is unclear how PPV works in patients with MacTel associated with cavitation or FTMH. A number of hypotheses may be considered based on previous studies. Zhu et al. [26] reported that, during MacTel progression, simple Müller cell injury causes development of intraretinal cysts but does not directly cause damage to photoreceptors. In other words, MacTel with cavitation or FTMH occurs when the inner retina cyst is affected by a deep retinal defect due to additional factors such as secondary retinal ischemia [17,27,28]. This may be why cavitation or FTMH is not common in MacTel. In patients with diabetes mellitus (DM), retinal ischemia is caused by retinal vascular changes that cause diabetic macular edema. This results in liquefaction necrosis of Müller cells and damages adjacent neural cells. Cystoid cavity formation subsequently occurs and is followed by LH [29-31]. This process is similar to progression of MacTel. The only difference between the two diseases is whether Müller cell damage or vascular change occurs first.

Vitreomacular traction may be another factor. Kimura et al. [28] reported a case of disappearing foveal cyst after spontaneous posterior vitreous detachment (PVD) in MacTel with intraretinal cysts, photoreceptor disruption, and LH. The presence of an epiretinal membrane (ERM) is another

factor that can cause secondary retinal ischemia. Karth et al. [14] reported that surgical results of patients with MacTel and MH were better when the disease was accompanied by ERM. Finally, systemic hypertension is regarded as a risk factor of cavitation or FTMH associated with MacTel. The proportion of patients with hypertension was higher in our study (6/8, 75%) than in previous reports (MacTel without cavitation or FTMH 17-50%) [32,33].

Surgical treatment seems to suppress progression of cavitation or FTMH by eliminating traction factors and improving some aspects of secondary retinal ischemia. From this perspective, PPV is helpful in patients with MacTel-associated cavitation or FTMH with concurrent ERM before onset of PVD or retinal circulatory problems (DM or hypertension).

It is unclear why the surgical results of this study are better than those of previous reports. Racial differences or differences in surgical technique, such as extent of ILM peeling, might have affected results. Further studies are needed.

Our study has several limitations. First, fluorescein angiography was not performed in all enrolled patients. However, OCT was performed for both eyes in all patients. Characteristic OCT findings were confirmed in the contralateral eye to minimize diagnostic errors. Another limitation is our small sample size, although it is larger than previous reports.

Despite these limitations, this is the first study reporting surgical outcomes for MacTel with cavitation or FTMH in Asian patients. Additionally, the surgical outcomes were comparatively positive. In conclusion, our results suggest that the surgical outcome for patients with MacTel-associated cavitation or FTMH is better than that found in past reports.

Conflicts of Interest

The author declares that there is no conflict of interests regarding the publication of this paper.

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