USE OF OPTICAL COHERENCE TOMOGRAPHY TO MEASURE PREVALENCE OF EPIRETINAL MEMBRANES IN PATIENTS REFERRED FOR CATARACT SURGERY

PREVALENCIA DE MEMBRANAS EPIRRETINIANAS MEDIANTE TOMOGRAFÍA DE COHERENCIA ÓPTICA EN PACIENTES REMITIDOS PARA CIRUGÍA DE CATARATAS

ABSTRACT

Purpose: To evaluate, using optical coherence tomography (OCT), the prevalence of epiretinal membranes (ERM) in patients referred for phacoemulsification, and the frequency of new ERM development in the first six months after surgery.

Methods: Patients referred by general ophthalmologists for cataract surgery underwent a new, complete ophthalmological evaluation. OCT scanning was performed using the Macular Thickness Map acquisition protocol (StratusOCT, Carl Zeiss Meditec). This baseline examination was used to determine the prevalence of ERM in patients referred for cataract surgery. All patients underwent uneventful phacoemulsification. If an ERM was already present in one eye, the other eye was chosen for cataract surgery. If no ERM was present, the eye with the poorest visual acuity was operated. Operated eyes were followed-up for six months in order to study the influence of phacoemulsification on the development of ERM.

Results: Forty-five patients were prospectively evaluated. In the baseline visit, ERM were detected by OCT in 7 patients (15.6%). Both eyes were affected in one patient, with the ERM being apparent on funduscopia only in the right eye. The ERM were not...
INTRODUCTION

Epiretinal membranes (ERM) are characterized by the proliferation of anomalous tissue on the surface of the retina. They may be the result of different ocular pathologies (retinal vascular disorders, intraocular tumors, inflammatory ocular disorders, ocular traumas, retinal detachments …) or else appear after eye surgery (1-3). ERMs in healthy eyes without any ocular anomaly nor a previous history of associated diseases are known as idiopathic ERMs.

ERMs are formed by retinal glial cells migrating to the retina’s surface through ruptures along the internal limiting membrane (ILM) (4). Posterior vitreous detachment (PVD) may be involved in the pathogenesis of idiopathic ERMs when tearing occurs in the ILM; this theory is backed by numerous studies that found a greater prevalence of PVD in patients suffering from ERM versus other populations with the same gender and age (1,4-8). Clinically, ERMs appear as changing light reflexes under ophthalmoscopy (9), resulting in scarce or no changes to the retinal surface. At this stage, known as «cellophane macular reflex» (CMR), the patient usually displays no symptoms (10). As the disease progresses, the pre-retinal cell layer thickens and then contracts, leading to the development of retinal flaps. This type of ERM, whereby light reflexes turn opaque and grey, is called «premacular fibrosis» (PMF). Patients may present loss of visual acuity (VA) or metamorphopsia.

Recently, several population studies have attempted to explore ERM prevalence. In such studies, ERMs were diagnosed mainly by means of retinography assessment; while others report that the eye fundus also underwent examination under biomicroscopy. Prevalence rates range from 2.8 percent in Japanese populations and 19.0 percent among Latinos in the U.S.A. (2,3,11-14).

Cataract surgery is thought to be one cause of secondary ERMs, since transversal and retrospective studies found a greater ERM prevalence among aphakic and pseudophakic patients. However, recent publications cast doubts over the likelihood of uncomplicated phacoemulsification leading to ERM formation (15).

The purpose of the present study is to assess ERM prevalence among patients referred for cataract surgery as well as the frequency of new ERMs during the first six months after surgery, by means regular examinations with optical coherence tomography (OCT).

SUBJECTS, MATERIAL AND METHODS

All patients referred for cataract surgery by one of the authors (JT) between April and June 2005 were assessed. Patients had been previously examined by a general ophthalmologist who determined the presence of cataracts to be the cause of visual loss. All patients were subjected to new full ophthalmologic exploration, including VA, biomicroscopy and cataract assessment based on LOCS III [Lens Opacities Classification System III (16)],...
applanation tonometry, indirect ophthalmoscopy and biomicroscopic assessment of the posterior pole with a non-contact lens. OCT exploration was performed using the Macular Thickness Map (StratusOCT, Carl Zeiss Meditec, Dublin, CA, USA) scanning protocol. Patients with ocular pathologies were excluded, except for rare macular drusen, PVD or slight, non-specific changes in the retinal pigment epithelium. Patients whose cataracts were too dense to yield clear OCT signals and those whose axial length went beyond the OCT’s focus range were also excluded. All patients signed an informed consent once they understood the study’s features.

EMR prevalence among patients referred for cataract surgery was obtained during initial exploration. Whenever EMR was present in one eye, the other was scheduled for cataract surgery. In the absence of EMR, surgery was scheduled for the eye exhibiting the lowest VA. The patients’ six-month follow-up after surgery aimed at studying the impact of phacoemulsification on EMR development.

Cataract surgery entailed performing a temporal clear cornea incision. After phacoemulsification, a folding silicon lens (Cee-on Edge®, AMO) was placed in the capsular sac; subsequently, 1 mg cefuroxime (Curoxima®, Roche) was injected into the anterior chamber. Patients were assessed on the day after surgery, as well as 2, 6, 12 and 24 weeks later. All checkups included full ophthalmologic assessment, including OCT exploration in weeks 6, 12 and 24.

The Macular Thickness Map scanning protocol entails performing six radial scans focusing on the fovea, fitted in place by internal fixation. All examinations were performed by two of the authors (IC, SN) after pharmacologic miidrasis, saving only those images that fulfilled subjective quality criteria. Furthermore, once the exam was deemed fit for analysis, it was assessed once more using the Retinal Thickness Analysis Protocol to check whether the OCT software had adequately identified the different retinal layers in at least five out of six scans. Whenever retinal borders were poorly delineated in one single scan, the examination was manually discarded from analysis; if not, the whole scanning protocol was cancelled and the examination had to be repeated. The authors analyzed every image in order to determine the presence of ERMs. Macular volume and mean retinal thickness, 1mm in diameter and centered on the fovea (central macular thickness), were obtained using the Retinal Thickness/Volume Protocol.

The statistical analysis was performed using SPSS 12.0 software (SPSS for Windows, SPSS Inc, Chicago, Illinois). Non-parametric tests were used for all variables. For statistical analysis, VA was converted to the logMAR scale. Visual acuity, central macular thickness and macular volume for the different groups were compared using Mann-Whitney’s test. Correlations between VA and tomographic measurements were established using Spearman’s rank correlation test.

RESULTS

Forty five patients were included in the study; 17 males and 28 females, with a median age of 73 years (range from 29 to 88 years). During the initial visit, the OCT detected ERMs among seven patients (15.6 percent). One female patient exhibited bilateral involvement, whereas the ERM was only evident in the left eye under eye fundus exploration (fig. 1). In the remaining cases, eye fundus exploration did not reveal any changes worth mentioning. ERMs looked under OCT like thin hyper-reflective bands along the retina’s surface leading to changes in the foveal contour (fig. 2).

Table I illustrates VA basal for all eyes later undergoing surgery, together with contralateral eyes with and without ERM. Among those eyes not undergoing surgery, those with ERM exhibited lower VA than those without ERM (p=.027, table I). The female patient suffering from a bilateral ERM was not included in Table I. Her VA improved from 0.7 to 0.4 logMAR units in the eye operated on. Visual acuity improved in the remaining eyes operated on, going from 0.80 to 0.42 logMAR units (p<.001).

Central macular thickness was significantly greater in eyes with ERM: 334.71 µm, standard deviation (SD) 92 versus 211.16 µm DE 27.12; p<.001. Six patients with EMR recorded central macular thickness values above 250 µm. Macular volume was also significantly greater in eyes with ERM: 8.26 mm³, SD 1.08 versus 6.89 mm³, SD 0.5 (p<0.01). No statistically significant correlations were found between VA and central macular thickness nor between VA and macular volume.

After a 6-month follow-up, eye fundus exploration and OCT did not reveal new ERM cases among
those eyes that had undergone cataract surgery. Nor were any new membranes diagnosed during this period in non-operated contralateral eyes.

**DISCUSSION**

In recent times, several population studies have attempted to determine ERM prevalence. Most of them view ERMs diagnosed in pseudophakic patients as secondary membranes. Prevalence rates reported by these studies differ significantly (2,3,11-14). ERMs are classified as either cellophane macular reflex (CMR) or pre-macular fibrosis (PMF). A more detailed analysis shows that PMF prevalence is similar in all these studies (ranging from 1.1 to 1.9 percent), whereas CMR rates were the main source of variation.

McCarty et al considered the possibility of CMR rate differences could result from the use of different assessment systems (number of eye fundus photographs, stereoscopic photographs) or from the

**Table I. Visual acuity among operated and contralateral eyes during follow-up**

<table>
<thead>
<tr>
<th>Visit</th>
<th>VA operated eye</th>
<th>VA contralateral eye</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Snellen Mean (SD)</td>
<td>All</td>
</tr>
<tr>
<td>Baseline</td>
<td>0.41 (0.20)</td>
<td>0.65 (0.28)</td>
</tr>
<tr>
<td>Week 6</td>
<td>0.74 (0.18)</td>
<td>0.67 (0.27)</td>
</tr>
<tr>
<td>Week 12</td>
<td>0.78 (0.18)</td>
<td>0.60 (0.29)</td>
</tr>
<tr>
<td>Week 24</td>
<td>0.79 (0.16)</td>
<td>0.68 (0.27)</td>
</tr>
</tbody>
</table>

VA: Visual Acuity; SD: Standard Deviation.
differences in eye fundus pigmentation, which would make CMR more noticeable in Hispanic populations (11). When analyzing the traits of secondary membranes, it becomes clear that in surgical procedures different from cataract surgery, for instance retinal detachment surgery or retinal vein occlusion, PMF appears more frequently than CMR. Nevertheless, the proportion of CMR compared to PMF in the ERMs diagnosed after cataract surgery was very similar to that found in idiopathic membranes (2,12).

Traditionally, cataract surgery was thought to be responsible for ERMs. The reason was that several studies on ERM prevalence found higher values among pseudophakic patients (1-3,11-13). ERM diagnosis in these studies was based on retinographies and was only occasionally confirmed by means of lens exploration. Thus, one may suggest that the diagnosis of a pre-existing ERM could be underestimated in patients with cataracts, for whom it is usually difficult to obtain a clear and well-defined image of the eye fundus (16). Another element leading to confusion may be the fact that ERM patients may register worse VAs than those without ERM, thus increasing the likelihood of being referred for cataract surgery.

Up to 95 percent of patients with idiopathic ERMs also suffer from PVD, a much greater prevalence than that observed in other populations within similar age ranges (1,4,6). Thus, it is thought to be an ERM pathogenic mechanism, since vitreous detachment may lead to ILM tearing through which glial cells can reach the retina’s surface. It is also believed that cataract surgery may result in ERM formation due to PVD surgical induction and the resulting traction exerted on the vitreoretinal interphase (15). Nonetheless, no published study has been found that would provide an analysis of PVD incidence after cataract surgery.

Jahn et al analyzed ERM incidence after cataract surgery in an innovative way (15). Patients were assessed before and less than two weeks after surgery, the former being the baseline exploration. They found that ERM prevalence was approximately twice as high once a clear eye fundus image was obtained. This suggests that ERMs could go easily unnoticed in the presence of cataracts, since two weeks is too short a period to think that ERMs did not exist prior to surgery. The study also found that ERM prevalence increased from 14.8 percent (baseline assessment) to 25.3 percent after six months and to 27.3 percent twelve months after surgery. All cases diagnosed de novo were CMRs.

The main issue of the studies published so far is that ERM diagnosis was based on subjective assessments. Frequently, the presence or absence of a cellophane reflex is difficult to determine; more so when the image is not clear due to the presence of cataracts. OCTs allow for obtaining retinal images with 10 µm axial resolution (17,18). Although the presence of cataracts may interfere with optic signal transmission, any experienced examiner should be capable of obtaining clear images in spite of the presence of a relatively dense crystalline sclerosis (19,20). Previous studies have reported that, even though ERMs may not always be identified with absolute certainty in OCT images, a distortion in the normal foveal architecture is almost always present (21-25). Detecting such distortions should lead examiners to more detailed analyses of topographic images, where it is almost always possible to identify ERMs, at least partially (fig. 2).

The present study found a 15.6 percent ERM prevalence among patients referred for cataract surgery; this rate is high, similar to that described for aphakic and pseudophakic patients in the above epidemiologic papers (2,3,12-14). The fact that most of these ERMs were not evident under ophthalmoscopy, combined with the absence of newly detected ERMs during the six-month follow-up after cataract surgery, suggest that the frequency of undetected ERMs may be higher than expected. The present study was designed to include a six-month follow-up period since, according to Jahn et al, the incidence of new ERMs did not increase significantly during the six- to twelve-month follow-up (15).

The OCT seems to be a more accurate ERM detection technique than eye fundus photography, specially among patients with crystalline sclerosis. The results obtained suggest the possibility of ERMs previously associated with phacoemulsification not being the result of surgery, but are simply better diagnosed once a clear eye fundus image is obtained. Most of these membranes fall under the CMR category, which are mainly asymptomatic and likely to go unnoticed after cataract surgery.

We are aware of the limited number of patients included in the present study and thus the difficulty of reaching conclusions. However, it does suggest that cataract surgery, or at least minimally aggressive phacoemulsification techniques used today, are not directly linked to ERM development during the
first six months after surgery. Wider studies are needed in order to determine for good whether phaco-emulsification can trigger ERM development or not.

REFERENCES