Taiwan Journal of Ophthalmology 6 (2016) 21–25

Contents lists available at ScienceDirect

Taiwan Journal of Ophthalmology

journal homepage: www.e-tjo.com

Original article

Correlation of spectral domain optical coherence tomography findings in sub-silicone oil foveal depression space and visual outcome in eyes undergoing silicone oil removal

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A R T I C L E I N F O

Article history:
Received 15 September 2015
Received in revised form
25 October 2015
Accepted 24 November 2015
Available online 13 February 2016

Keywords:
hyper-reflective spherical bodies
silicone oil emulsification
silicone oil removal
spectral domain optical coherence tomography
sub-silicone oil-foveal depression space

A B S T R A C T

Background/Purpose: To describe small hyper-reflective spherical bodies in sub-silicone oil-foveal depression (SSO-FD) space using spectral domain optical coherence tomography (SD-OCT) and its effect on visual outcomes in eyes undergoing silicone oil removal (SOR).

Methods: This was a prospective interventional comparative study comprising 42 eyes undergoing SOR with clear media. All patients underwent detailed clinical examination and SD-OCT scan of fovea preoperatively and at 30 days and 90 days postoperatively. Patients were divided into Group A ($n = 21$) and Group B ($n = 21$) depending on presence or absence, respectively, of small hyper-reflective spherical bodies in the SSO-FD space in preoperative scans. The findings between SD-OCT and best-corrected visual acuity were correlated and analyzed.

Results: The mean age of patients was 41.9 years (range, 23–60 years) in Group A and 45.6 years (range, 23–60 years) in Group B. Twenty-one eyes showed small hyper-reflective spherical bodies on SD-OCT imaging. These were thought to represent emulsified silicone oil globules trapped in the potential space created by silicone oil meniscus and foveal pit, which is the SSO-FD space. These bodies were absent in all post SOR scans of Group A and Group B. Group A had significant visual improvement ($p = 0.0001$) after SOR with clearance of these hyper-reflective bodies as compared to Group B ($p = 0.356$).

Conclusion: We conclude that these small hyper-reflective spherical bodies in the SSO-FD space were most likely emulsified silicone oil globules and correlated with significant visual improvement with their clearance after silicone oil removal.

1. Introduction

Silicone oil (polydimethylsiloxane) is a linear synthetic polymer composed of repetitive Si–O units and meets all the requirements for intraocular use and can be considered as the ideal material for intraocular tamponade.[1] Cibis et al[2] first reported the use of silicone oil in vitreoretinal surgery in 1962. Later Scott[3] and Zivojnovic et al[4] used this technique in the treatment of complicated retinal detachments with proliferative vitreoretinopathy. In the current era, the use of silicone oil as a surgical tamponade has become a standard technique in the treatment of retinal detachments, especially in proliferative vitreoretinopathy and tractional retinal detachments, severe cases of diabetic retinopathy, endophthalmitis, viral retinitis, and ocular trauma.[5]

Emulsification of silicone oil is a well-known phenomenon that is encountered in patients who have had silicone oil tamponade for variable periods leading to secondary complications. Although recommendations range from 3 months to 6 months, there is still no definite agreement on the optimal removal time.[6–8] There is scant scientific knowledge about the *in vivo* emulsification process of silicone oil intraocularly. Experimental and histopathology studies have shown that silicone oil droplets

Conflict of Interest: The authors have no conflicts of interest to declare.

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http://dx.doi.org/10.1016/j.tjo.2015.11.001

are deposited within the retinal tissues, optic nerve, and anterior segment structures including the cornea, uveal tissue, and trabecular meshwork.[9–12]

Chung and Spaide[13] reported the use of first-generation OCT to demonstrate intraretinal silicone oil vacuoles in a single patient who underwent macular hole surgery with internal limiting membrane peeling and temporary silicone oil tamponade. Another study by Errera et al[14] reported the use of SD-OCT in the detection of epiretinal, intraretinal, or subretinal hyper-reflective areas and hypothesized it to be small bubbles of emulsified silicone.

We have noted small spherical bodies in the foveal depression below the silicone oil meniscus showing hyper-reflectivity on SD-OCT scanning. We termed these bodies as hyper-reflective spherical bodies in the subsilicone oil foveal depression (SSO-FD) space. These bodies probably interfere to some extent with central visual acuity. In our prospective comparative study, we compared a group with small hyper-reflective spherical bodies in the SSO-FD space using SD-OCT with a group with no such bodies, and established their correlation with improvement in visual acuity after silicone oil removal.

2. Methods

After Institutional Ethics Committee (Retina foundation, Ahmedabad) approval, 42 eyes of 42 patients who met with all the inclusion and exclusion criteria were enrolled in this study with informed consent. Patients who underwent primary vitrectomy with silicone oil tamponade for rhegmatogenous retinal detachment (macula off), having clear media with settled retina on clinical examination and with a minimum 3 months of post-silicone oil removal follow-up were included in the study. The same medical grade and viscosity silicone oil (1000 centistokes) was used in all patients after vitrectomy. The patients with any complications such as cataract, glaucoma, hyperoleon, or band-shaped keratopathy hampering the OCT scan, or responsible for reduced visual acuity during follow-up of 3 months were excluded. Patients who developed repeat retinal detachments within 3 months after SOR and patients in whom foveal contours were lost due to macular pathology, such as epiretinal membrane, scaring, or macular edema, were excluded.

All patients underwent detailed clinical examination including best-corrected visual acuity (BCVA), intraocular pressure measurement and SD-OCT scans before silicone oil removal and at 30 days and 90 days postoperatively. SD-OCT examination was carried out with a Spectralis HRA+OCT device (Heidelberg Engineering, Heidelberg, Germany) equipped with an eye-tracking system for the simultaneous acquisition of near-infrared reflectance ($\lambda = 815$ nm), and SD-OCT images with an illumination wavelength of 870 nm and an acquisition speed of 40,000 A scans per second and 7 μ axial resolution. Horizontal and vertical lines as well as volume scans were performed in the morning before silicon oil removal by the surgeon. The patients were followed up at 30 days and 90 days postoperatively.

For each eye, a standard protocol of SD-OCT imaging using the horizontal and vertical scans 30° (8 mm length) and full volume scan containing 19 B scans (30° × 15°) was used. Distance between B scans: 240 μm and 768 A scans was utilized. On follow-up visits, the same areas were scanned using the scanner software by taking progressive reference scan options so as to prevent any observer subjective bias.

Depending on the presence (Figures 1A, 2A,and 2C) or absence (Figure 3A) of small hyper-reflective spherical bodies in the SSO-FD space in preoperative scans, patients were divided into Group A and Group B. The correlations between preoperative and postoperative SD-OCT findings and BCVA were analyzed. Statistical significance was calculated based on negative ranking using Wilcoxon signed ranks test, Mann–Whitney U test, χ^2 and Student t test as appropriate.

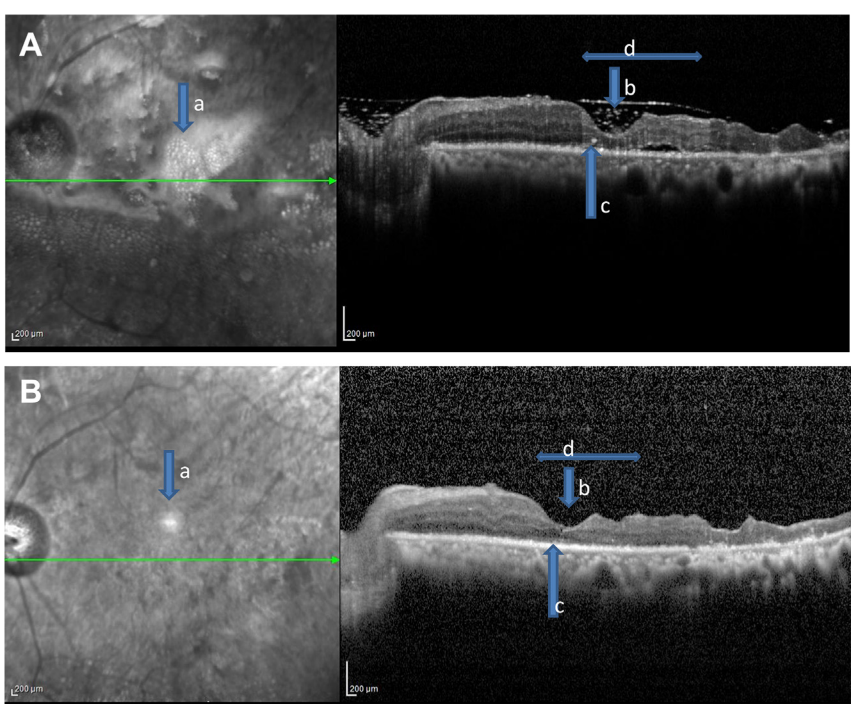

Figure 1. (A) Preoperative red-free fundus photograph and spectral domain optical coherence tomography scan in Group A showing: a, foamy glistening sheen; b, hyper-reflective bodies in sub-silicone oil-foveal depression space; with c, intraretinal hyper-reflective bodies; and d, after shadowing/back scattering on retinal layers. (B) Post-silicone oil removal red-free fundus photograph and spectral domain optical coherence tomography scanning in Group A showing: a, absence of foamy sheen; and b, no hyper-reflective bodies in sub-silicone oil-foveal depression space. The c, intraretinal hyper-reflective bodies; and d, after shadowing/back scattering on retinal layers are also absent.