Persistent anterior chamber silicone oil and myopia

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Abstract

A 60-year-old male experienced a marked unilateral myopic shift of 20 D following attempted removal of intravitreal heavy silicone oil (HSO) used in the treatment of inferior proliferative vitreous retinopathy following retinal detachment. Examination revealed HSO adherent to the corneal endothelium forming a convex interface with the aqueous, obscuring the entire pupil, which required surgical intervention to restore visual acuity. This case highlights the potential ocular complications associated with silicone oil migration into the anterior chamber, which include corneal endothelial decompensation and a significant increase in myopia.

Introduction

The surgical treatment of proliferative vitreous retinopathy (PVR) associated with complicated retinal detachment typically involves vitrectomy and injection of silicone oil.[1] The heavy silicone oil (HSO) tamponade provides inferior retinal support increasing the likelihood of retinal reattachment.[2] This case report describes a patient with a history of vitreoretinal procedures including a HSO tamponade for PVR. Postoperative persistent silicone oil adherent to the corneal endothelium resulted in an extreme myopic shift and significant anisometropia which required surgical intervention to restore visual acuity. The optical changes associated with the use of silicone oil are discussed, along with potential sequelae of silicone oil accumulation within the anterior chamber.

Case Report

A sixty-year-old Caucasian male was referred for corneal assessment following a marked 20 D monocular myopic shift following a series of vitreoretinal procedures. The patient was a high myope (OD -7.50/-1.50 x 8, OS -7.50/-1.75 x 177) and had undergone right combined cataract removal, intraocular lens (IOL) implantation and pars plana vitrectomy (with a balanced saline solution only) for dense vitreous floaters. The postoperative refraction was OD -4.00/-1.50 x 24. A shallow temporal right retinal detachment developed one month postoperatively which was treated with a scleral buckle and cryocoagulation. Inferior PVR subsequently developed within one month which was managed with pars plana vitrectomy and HSO (Oxane HD, Bausch and Lomb, Surrey, UK) tamponade. Immediately prior to removal of the

HSO, the spectacle-corrected visual acuity (SCVA) was OD 20/200 and IOP was 18 mmHg. Following removal of the silicone oil three months post vitrectomy, the patient displayed marked myopic anisometropia of approximately 17 D SCVA of OD 20/200 (-24.00/-1.50 x 8) and OS 20/15 (-7.50/-1.75 x 177). Intraocular pressure was OD 14 mmHg and the right retina was attached on fundus biomicroscopy. Slit lamp examination revealed a stable IOL and a large globule of HSO (approximately 10 mm high x 7 mm wide) adhered to the corneal endothelium obscuring the visual axis and the entire pupil (Figure 1A). Anterior segment imaging with optical coherence tomography demonstrated the convex interface with the aqueous humor of approximately 1.8 mm in depth (Figure 2A). The patient was taken to operating theater and the HSO removed under topical anesthesia. A Simcoe cannula (Katena Products, Inc, Denville, USA) with a 0.3 mm aspiration port and 23 gauge interior was used to perform irrigation and aspiration via a paracentesis. The HSO was found to be relatively adherent to the endothelium and extreme care had to be taken to minimize collateral endothelial damage.

On day one following removal of the anterior chamber oil, the SCVA was OD 20/250 with mild corneal edema which improved to 20/50 (OD -3.50/-2.00 x 15) at week one follow up. The majority of the centrally placed HSO was cleared, however an incomplete annulus of oil remained adherent to the endothelium in the mid-periphery (Figure 1B and 2B). Two months later, the SCVA had further improved to 20/30, but the annulus of residual silicone oil remained attached to the corneal endothelium. Specular microscopy showed a reduced endothelial density of 1767 cells/mm^2 with increased polymegathism and cellular dropout (Figure 3). A decision was made to perform further irrigation and aspiration in order to more fully remove the HSO. On

day one post-procedure, the SCVA was OD 20/200 which improved to 20/30 at week three with a stable refraction of OD -3.50/-2.00 x 15 (Figure 1C).

Discussion

Refractive changes associated with silicone oil tamponade have been well documented and vary depending on the refractive index of the oil and lens status (i.e. the curvature of the crystalline lens or IOL/silicone oil interface or the anterior chamber aqueous humor/silicone oil interface determines the sign and magnitude of the refractive change).[3-5] In aphakes, a myopic shift occurs as a result of the convex oil/aqueous interface through the pupil, while in phakic or pseudophakic patients a hyperopic shift is typically observed as the more dense silicone forms a concavity around the posterior crystalline lens or IOL surface. Residual silicone oil attached to the anterior IOL surface or the posterior capsular bag may also result in a significant myopic shift,[6] however, this is the first case report to document a marked (20 D) increase in myopia as a result of persistent HSO adherent to the corneal endothelium.

We calculated the theoretical refractive change expected as a result of the HSO (n = 1.400) adherent to the posterior cornea (n = 1.376) in the shape of a biconvex lens (1.82 mm central thickness) with the posterior surface of the oil interfacing the aqueous humor (n = 1.336) based on the biometrics obtained from a single horizontal line scan of an anterior OCT image centred on the pupil (Figure 2A). The radius of curvature of the posterior cornea (6.65 mm) and the posterior surface of the oil (6.32 mm) were calculated using the SAG formula with a 6.53 mm chord (the

equatorial diameter of the biconvex shaped oil lens in the scan). The expected refractive change along this single horizontal meridian was a myopic shift of 13.74 D; a 3.61 D contribution from the cornea/oil interface and 10.13 D from the oil/aqueous interface. Hence, the total refractive change observed in this case as a result of the adherent silicone oil (~20 D) appears to be further influenced by the posterior surface topography of the oil over the entire pupil, not the single meridian considered in isolation as outlined above.

Silicone oil from the vitreous chamber may enter the anterior chamber via a patent peripheral iridectomy, capsular rupture or zonular dehiscence and may be difficult to detect under the operating microscope using diffuse bright illumination. A thin angled slit beam allows better visualisation of the silicone-aqueous interface, however the oil can also be visualised with alternative ocular imaging modalities such as OCT or a scanning laser ophthalmoscope as demonstrated in this case.

Perfluorohexyl-octane ($C_{14}F_{13}H_{17}$ [F6H8]) (Fluron GmbH, Ulm, Germany), a silicone oil solvent, has been used in the removal of silicone adherent to IOL surfaces.[7] However, there are no reports of its use removing silicone oil from the corneal endothelium and in vitro studies have shown a cytotoxic effect on the corneal endothelium following long-term contact.[8,9] Several cases of silicone oil adherent to the retina have also been described.[10] This so called “sticky” silicone oil is thought to result from a combination of a reduction in surface tension of surrounding aqueous fluid and the contamination of the silicone oil (i.e. impurities within the tamponade media) which increase adhesion.[11] While in the current case the HSO was attached to the cornea, a similar process may have occurred which enhanced adhesion (in the

anterior or vitreous chamber), as the oil required two procedures for complete removal from the anterior chamber.

This patient experienced a large refractive shift as a result of residual anterior chamber silicone oil as well as evidence of endothelial cell decompensation. These corneal changes have been attributed to the barrier effect of silicone oil disrupting the aqueous/endothelium interface rather than a cytotoxic effect of the silicone oil and therefore complete removal of silicone oil is important.[12] Secondary glaucoma resulting from anterior chamber oil emulsification has been observed to occur in 10% of eyes treated with intravitreal silicone oil followed for a minimum of one year.[13] Acute intraocular pressure spikes can also occur in phakic and aphakic eyes following intravitreal silicone oil injection due to pupil block from the silicone oil.[14] Peripheral iridectomy prevents this occurring, however may also provide another entry passage of intravitreal silicone oil into the anterior chamber.

Conclusion

HSO tamponade is a useful device employed for complicated inferior retinal detachments. Potential anterior chamber complications arising from oil migration include not only secondary glaucoma and compromised corneal endothelium, but a significant myopic shift due to the higher refractive index of silicone compared to the aqueous and the tendency for the oil to remain coalesced as a result of surface tension. Removal of the HSO corrects the induced refractive error and reduces the risk of longer term endothelial decompensation.

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Figure 1: Slit-lamp view of: (A) silicone oil in the anterior chamber attached to the corneal endothelium (10mm high x 7 mm wide) obscuring the entire pupil, (B) residual incomplete annulus of oil attached to the endothelium in the mid-peripheral cornea and (C) clear anterior chamber following the second irrigation and aspiration procedure.

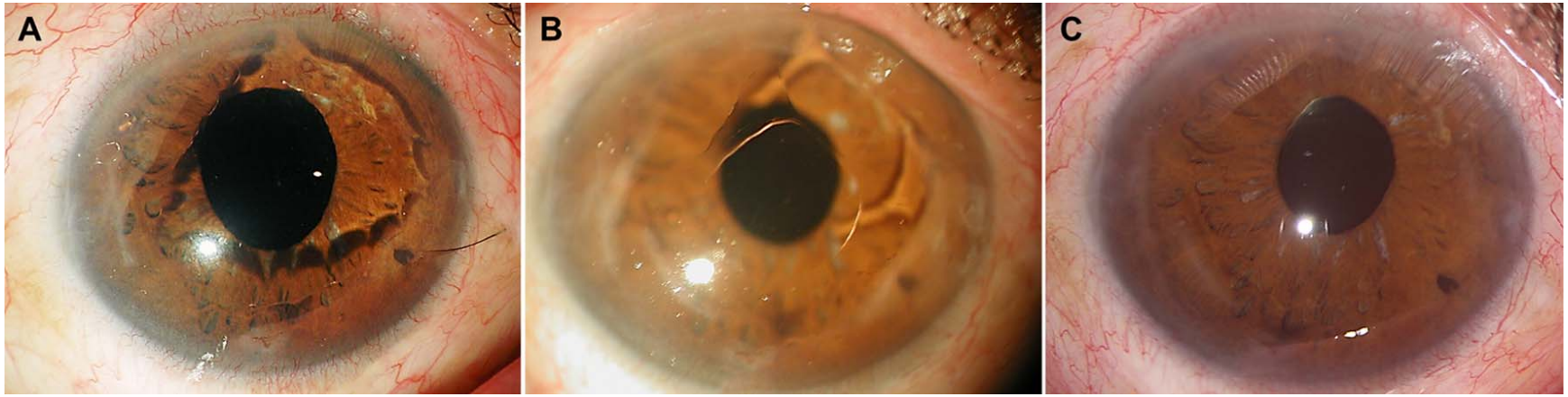

Figure 2: Anterior optical coherence tomography image (a single horizontal cross section centred on the pupil) of the silicone oil attached to the corneal endothelium at: (A) initial presentation and (B) following the first irrigation and aspiration procedure. Inset: scanning laser ophthalmoscope images.

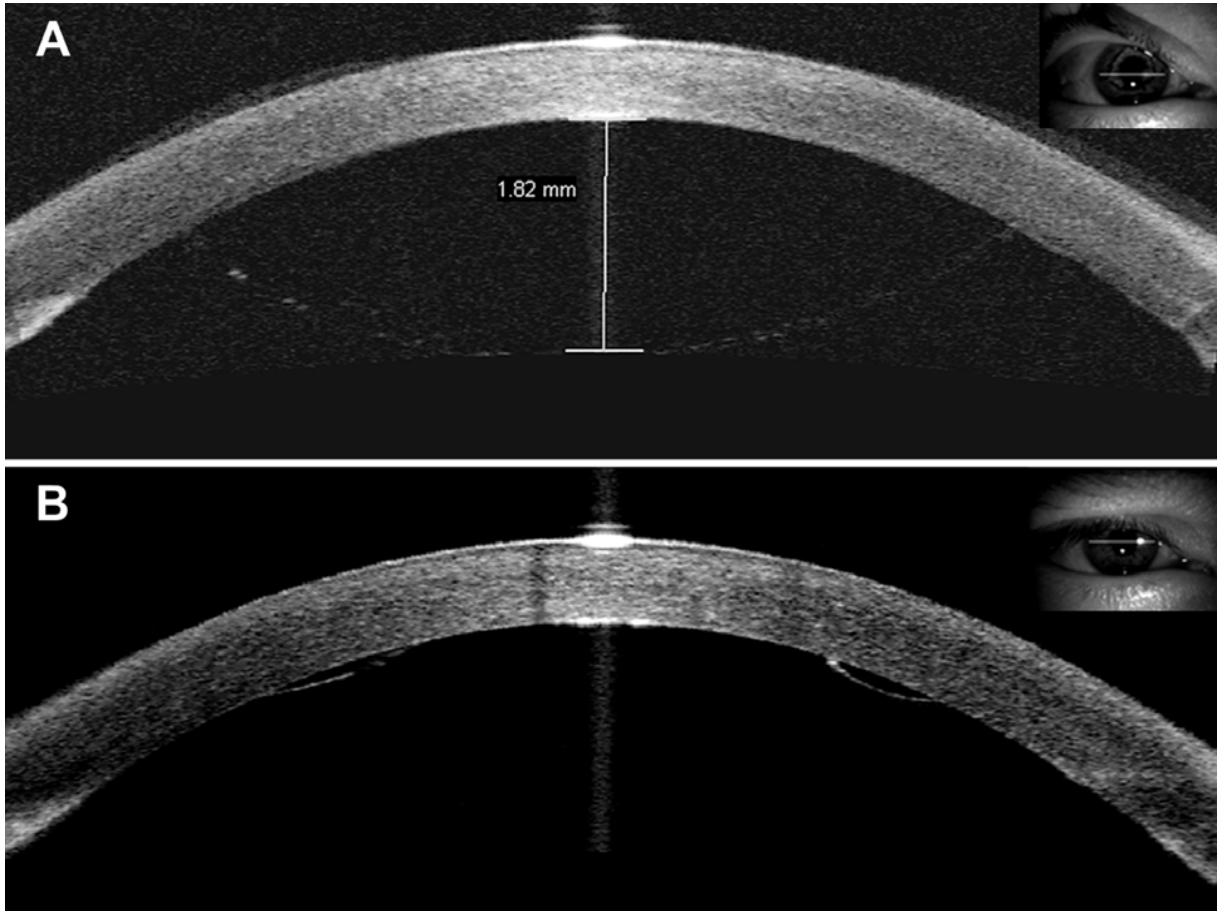

Figure 3: Specular microscopy **i**mages of the right (A) and left eye (B) following the initial procedure to remove the anterior chamber silicone oil with endothelial cell densities of OD 1767 cells/mm^2 and OS 2725 cells/mm^2. The right endothelium displays marked endothelial polymegathism.