Silicone oil (SO) is a long-term intraocular tamponade used for a variety of retinal disorders. In aphakic eyes with an intact iris, the use of an inferior peripheral iridectomy prevents SO prolapse into the anterior chamber, thereby preventing glaucoma and keratopathy. We have developed a technique for preventing SO from entering the anterior chamber in aphakic eyes with iris loss. The technique involves placing 10-0 prolene sutures (SO retention sutures) across the anterior chamber to simulate an iris diaphragm. The sutures act as a barrier between the SO and aqueous, preventing SO-corneal contact. Images of this phenomenon were obtained by high-frequency ultrasound biomicroscopy with patients in the supine position. Silicone oil retention sutures may be an effective means to prevent SO-corneal touch in aphakic eyes with iris loss.

Silicone oil (SO) is an effective intraocular tamponade used in treating complex retinal detachments. In aphakic eyes, the use of SO may lead to corneal decompensation and/or glaucoma if the oil contacts the corneal endothelium and/or the trabecular meshwork. However, in aphakic eyes with iris loss, SO is considered a relative contraindication because it usually enters the anterior chamber. Silicone oil is frequently needed in severe trauma cases with retinal injury; however, associated iris damage often precludes its use.

The purpose of our article is to describe a technique used to prevent SO from entering the anterior chamber despite loss of an intact iris diaphragm. Our technique involves placing sutures across the anterior chamber to simulate an iris diaphragm. We refer to these sutures as SO retention sutures and demonstrate their ability to prevent SO-corneal touch using high-frequency ultrasound biomicroscopy with patients in the supine position.

METHODS

The technique uses 10-0 prolene sutures on an STC-6 needle (model 1713; Ethicon, Somerville, New Jersey) that are placed across the anterior chamber from sulcus to sulcus. The 16-mm (STC-6) needle is inserted 1 mm posterior to the limbus from one side of the anterior chamber and retrieved across the other side within the bore of a five-eighths–inch long 25-gauge needle attached to a 1-mL syringe. Although initial experience with fewer sutures was effective, we currently attempt to use 4 sutures to form a 5- to 6-mm sided square centered on the visual axis. The sutures lie within the plane of the previous iris (Figure 1). Each suture is passed across twice, 1 mm apart. The knot is rotated through the 25-gauge suture tract, and the exposed suture is covered with conjunctiva. The fluid-air exchange and SO injection are performed after the sutures are placed.

In our study, high frequency ultrasound biomicroscopy (UBM) (Zeiss-Humphrey, San Leandro, California) was used to image the anterior segment and the SO-aqueous interface.
Our unit operated at 50 MHz and achieved a tissue resolution of approximately 50 µm. Scanning was performed with the patient in the supine position using a 20-mm eye cup placed on the eye and filled with a 2.5% methylcellulose-saline combination after receiving topical anesthesia. The ultrasound probe was placed in the coupling medium approximately 2 to 3 mm from the ocular surface. Images were captured on a video printer, with particular attention given to imaging the SO-aqueous interface and the SO retention sutures.

Three patients are described who had SO retention sutures placed for traumatic retinal detachment and total iris loss. All patients had 5000-centistoke SO tamponade for retinal reattachment repair. The case reports and surgical procedures were performed with informed consent and adhered to the tenets of the Declaration of Helsinki and all the guidelines of the New York Eye and Ear Infirmary institutional review board.

REPORT OF CASES

CASE 1

A 50-year-old man received an open globe injury of the right eye during a motor vehicle accident. After primary repair was performed, the iris was noted to be absent, and B-scan ultrasonography revealed a dense vitreous hemorrhage with retinal detachment. Visual acuity was light perception. Ten days after the primary repair, the patient underwent retinal reattachment, and SO retention sutures were placed horizontally and vertically (Figure 1). Three months after surgery, visual acuity improved to 20/100, intraocular pressure was normal, and the retina was attached. The SO remained at the plane created by the retention sutures. Ultrasound biomicroscopic images demonstrated the ability of the retention sutures to prevent the SO from entering the anterior chamber and contacting the corneal endothelium (Figure 2).

CASE 2

A 47-year-old woman received a perforating BB injury to the right eye with the entrance site at the nasal limbus and the exit site at the macula. After primary repair was performed, the iris was noted to be absent, and B-scan ultrasonography revealed a dense vitreous hemorrhage with retinal incarceration in the posterior exit wound. Visual acuity was bare light perception. Two weeks after surgery, the SO remained posterior to the plane formed by the sutures with associated anterior chamber fibrin. Ultrasound biomicroscopic images demonstrated the SO-aqueous interface with intervening retention sutures and anterior chamber fibrin (Figure 3). The fibrin organized into a fibrous membrane on the suture-SO-aqueous plane (the retention sutures presumably served as the scaffold for the fibrous membrane). Four months later, the patient had repeated corneal transplantation, and holes were created in the fibrous membrane to simulate a pupil and a peripheral iri-
dectomy (Figure 4). Four months postoperatively, visual acuity improved to 20/160, intraocular pressure was 6 mm Hg, and the retina remained attached. The SO remained behind the new pupil with no SO-corneal touch.

COMMENT

Silicone oil is toxic to the corneal endothelium, and with prolonged contact, the cornea will develop severe edema and/or band keratopathy. Procedures to prevent SO from entering the anterior chamber are important to avoid these complications. In 1985, Ando described the use of an inferior peripheral iridectomy in aphakic eyes to prevent the prolapse of SO and pupillary block. The aphakic inferior iridectomy allows aqueous to enter the anterior chamber and prevents SO from touching the cornea. This procedure requires the presence of an intact iris diaphragm to be effective.

Many trauma cases, however, involve iris damage, and when an intact iris diaphragm is not present, SO may easily enter the anterior chamber. Several devices have been developed that attempt to prevent SO from entering the anterior chamber in these eyes. Heimann and Konen described an open iris diaphragm and Thumann et al subsequently described a closed diaphragm, both composed of poly(methyl methacrylate), that were implanted and sewed to the sulcus. The open diaphragm prevented SO-corneal touch in 40% of eyes (n = 20) and the closed diaphragm prevented this in 50% (n = 24). Failure was related to hypotony, fibrin formation, and poor fit. These devices were created in Europe and are not currently approved in the United States.

As demonstrated in our cases, SO retention sutures offer a method to prevent SO from entering the anterior chamber and touching the corneal endothelium in eyes with iris loss. The surface tension of SO in water, also called the silicone oil/water interface surface tension, is considered high (50 erg/cm²), although not as high as the gas/water interface surface tension (70 erg/cm²). The sutures take advantage of the high SO-aqueous interface surface tension. This interfacial tension, a result of both van der Waals and polar bonding forces, helps SO maintain a spherical shape in the eye. These forces are not only able to prevent the sutures from breaking the surface of the silicone globule but are strong enough to overcome the low buoyancy force of the SO. This phenomenon was demonstrated by ultrasound biomicroscopic images of our patients in the supine position. The sutures enhance the natural barrier that exists between the oil and the aqueous. Because the sutures rely on an intact SO-aqueous interface, success in using this technique would not be expected in an eye with an overfill of SO and/or inadequate aqueous production (ie, hypotony). As surgeons gain experience with this technique, a larger multicenter study can be performed to elucidate the factors contributing to the success or failure of SO retention sutures.

Retention sutures are not new to ophthalmology. Although not commonly performed, anterior segment surgeons have used them to protect the corneal endothelium. More than 30 years ago, Simcoe described both triangular and quadrangular temporary anterior chamber retaining sutures to prevent iris-fixated lenses from touching the corneal endothelium during lens implantation, corneal transplantation, and after glaucoma surgery. He described using a 9-0 or 10-0 nylon suture inserted through the peripheral cornea 1 mm anterior to the limbus and placed across the anterior chamber. Other variations of this technique have been described for preventing tube-corneal touch in eyes with an anterior chamber Molteno tube (Molteno Ophthalmic, Dunedin, New Zealand).

Figure 3. High-frequency ultrasound biomicroscopic image of the anterior chamber of case 3. The yellow arrow points to the silicone oil–aqueous interface; red arrows, the silicone oil retention sutures; and blue arrow, the anterior chamber fibrin.

Figure 4. Color slitlamp photograph of case 3. A fibrous membrane formed on the silicone oil–aqueous suture interface. During repeated corneal transplantation, a pupil and inferior iridectomy were created in the fibrous membrane. The original retention sutures act as the scaffold for the new pupil.
In summary, SO retention sutures can contain oil posteriorly because of the high SO-aqueous interface surface tension. This phenomenon was imaged by high-frequency ultrasound biomicroscopy with patients in the supine position. Silicone oil retention sutures may offer a means to prevent SO-corneal touch in aphakic eyes with iris loss.

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