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Retinal Toxicity of Silicone Oil

Mehrdad Motamed Shariati*; Arash Darvish
Eye Research Center, Mashhad University of Medical Sciences, Mashhad, Iran.

Corresponding Author:** **Mehrdad Motamed Shariati
Tel: +989377388690; Email: mehrdad_shariati2005@yahoo.com

Short commentary

Polydimethylsiloxane, known as silicone oil, belongs to a group of polymeric organosilicon compounds and is widely used in vitreoretinal surgery. The five physical properties of silicone oil (SO) that make it valuable in vitreoretinal surgeries include transparency, viscosity (1000-5000 centistoke), biocompatibility, high interfacial surface tension in aqueous solution, and positive buoyancy. The primary use of SO is to tamponade the retina in patients with rhegmatogenous retinal detachment (RRD) following pars plana vitrectomy (PPV) and endolaser photocoagulation until the chorioretinal adhesion is established [1].

Considering that SO is a biocompatible and safe compound, its use as a tamponading agent is very common in the field of vitreoretinal surgery. However, some postoperative complications have been reported about using SO. Table 1 summarizes previous study results regarding the complications associated with using SO.

In some patients with a history of PPV with SO injection, unexplained vision loss has occurred. Experts have proposed a variety of mechanisms to justify this finding. Retinal toxicity of SO can be due to the direct toxicity of small emulsified silicone particles on the retinal ganglion cells, modifications in the microcirculation of the macula or optic nerve head, and the neuro-destructive effects of growth factors that are sandwiched between the retinal surface and SO. Some studies have shown a significant positive correlation between the incidence of visual impairment and the duration in which SO has remained inside the vitreous. Furthermore, intraocular pressure rise is another significant factor affecting patients' visual status after using SO as a tamponade.

The presence of low-molecular-weight components (LMWCs) in SO is one of the factors contributing to retinal toxicity. LMWCs are composed of repeating dimethyl-siloxane units with a molecular weight of less than 2400 Dalton and are the most abundant component in all chemical impurities. In a study

Table 1: Silicone oil complications in vitreoretinal surgeries.

Authors	Year	Complications of SO
Yang et al [2]	2007	SO is cytotoxic for corneal endothelial cells and has to be removed as soon as possible.
Pichi et al [3]	2020	Particles of oil that migrate into the retina or come into direct contact with it both have the potential to cause direct damage to ganglion cells. Due to silicon oil's transparency, indirect harm may result from phototoxicity or inflammation brought on by cytokines wedged between the oil and the retina.
Federman et al [4]	1988	Cataracts developed in all phakic eyes during a follow-up period of 5 years. Band keratopathy occurs during 6 months when touched with SO. Pupillary block glaucoma occurred in 3% of patients. Fibrous epiretinal proliferation occurred in 15% of patients. Subconjunctival deposit of SO was observed in 3% of patients.
Miller et al [5]	2014	Keratopathy and glaucoma are common complications following SO emulsification.
Newsom et al [6]	2004	Unexplained vision loss after SO removal in 7 patients with good visual prognosis was reported.
Roca et al [7]	2017	After SO removal, 5.9% of eyes showed unexplained vision loss. Higher IOP and a longer SO tamponade time were factors linked to this occurrence.

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in 2021, Ying Chen et al. investigated the cytotoxic effects of LMWCs on retinal cells. They showed that most LMWCs have cytotoxic properties in liquid and emulsified forms and induce apoptosis in retinal cells [8].

Although employing SO for long-term tamponade in vitreo-retinal operations is a safe and low-complication alternative, its prolonged stay in the eye can have adverse effects like vision loss. More extensive research is required to comprehend the side effects and etiopathogenesis of vision impairment related to SO treatment.

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