

Comparison of the antimicrobial effect of heavy silicone oil and conventional silicone oil against endophthalmitis-causing agents

Nurgül Örnek, Teoman Apan¹, Reyhan Oğurel, Kemal Örnek

Purpose: To conduct an *in vitro* experimental study comparing the effectiveness of conventional silicone oil and heavy silicone oil against endophthalmitis-causing agents. **Materials and Methods:** The antimicrobial activity of conventional silicone oil (RS OIL 5000) and heavy silicone oil (heavySil 1500) was tested. The antimicrobial effects of both silicone oils were determined by the growing capability of the microorganism. **Results:** The number of *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Escherichia coli*, *Pseudomonas aeruginosa*, and *Candida albicans* decreased to zero levels at the second day of inoculation in heavy silicone oil. In conventional silicone oil, the microorganisms survived longer than in heavy silicone oil. **Conclusion:** Heavy silicone oil seems to be more effective than conventional silicone oil against endophthalmitis-causing agents.

Key words: Antimicrobial effect, conventional silicone oil, endophthalmitis agents, heavy silicone oil

Access this article online

Website:

www.ijo.in

DOI:

10.4103/0301-4738.126994

Quick Response Code:



Infectious endophthalmitis is one of the most devastating complications of ophthalmic surgeries and penetrating injuries. Although the microbial etiology of infectious endophthalmitis varies according to the clinical settings, the most common isolated microorganisms are Gram-negative bacilli, Staphylococci, Gram-positive bacilli, Streptococci, and fungi. Despite aggressive therapeutic and surgical interventions, endophthalmitis generally results in partial or complete visual loss, often within a few days of microbial inoculation. It has been hypothesized that complete vitrectomy in patients with endophthalmitis might ensure complete removal of both the vitreoretinal tractions and the microbial load within the vitreous cavity.^[1]

Silicone oil is a group of clear, inert, and hydrophobic polymers, chemically derived from siloxane. Currently, the main indications of its use are complicated cases and infectious endophthalmitis.^[2,3] They help by providing tamponade to inadvertent breaks, decreasing the spread of the microorganisms by compartmentalizing the eye. Experimental studies suggested that conventional silicone oil has bactericidal activity against various microorganisms.^[4,5]

The purpose of this study was to compare the effect of the conventional and heavy silicone oils on *in vitro* bacterial growth of selected microorganisms *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Escherichia coli*, *Pseudomonas aeruginosa*, and *Candida albicans*.

Departments of Ophthalmology and ¹Microbiology, School of Medicine, Kırıkkale University, Turkey

Correspondence to: Dr. Kemal Örnek, Department of Ophthalmology, School of Medicine, Kırıkkale Üniversitesi, Tıp Fakültesi, Göz Hastalıkları Anabilim Dalı, Kırıkkale, Turkey. E-mail: kemalornek@hotmail.com

Manuscript received: 5.11.12; **Revision accepted:** 13.09.13

Materials and Methods

An *in vitro* experimental study was conducted in the Laboratory of Microbiology of the Kırıkkale University School of Medicine. The antimicrobial activities of the two intraocular tamponades, conventional silicone oil (RS OIL, 5000, Alchimia, Italy) and heavy silicone oil (heavySil 1500, Alchimia, Italy), against *S. aureus*, *S. epidermidis*, *E. coli*, *P. aeruginosa*, and *C. albicans* were tested. The bacteria were suspended in physiologic saline to get 1-Mc Farland turbidity. Two samples of 0.1 ml and two samples of 0.5 ml were obtained from the microbial suspension. Two samples of 0.1 ml were inoculated into the 0.9-ml conventional silicone oil and heavy silicone oil. The 0.5-ml samples were inoculated into 4.5-ml brain-heart infusion, physiologic saline for bacteria, and Sabouraud broth for fungus. Negative controls were brain-heart infusion and physiologic saline without any inoculations.

The antimicrobial effect of both silicone oils was determined by the growing capability of the microorganism. The sterilized Müeller-Hinton agar growth medium was prepared (4 mm thick) for determining the bacterial growth daily. Before sampling, the tubes were carefully vortexed at 2500 rpm until bacteria/fungus and silicone oil mixture with evenly distributed microorganisms was obtained. Samples were taken from these liquids each day. A 10-ml sample was taken from the intraocular liquids and controls. The samples were inoculated and spreaded with single-use loop on Müeller-Hinton agar or Sabouraud broth. After 24 h in the incubator, bacterial growth was evaluated daily. After a 24-h period, growing colonies were counted as colony forming unit (CFU).

Results

Figs 1-5 show the antimicrobial effects of the two silicone oils against endophthalmitis causing agents.

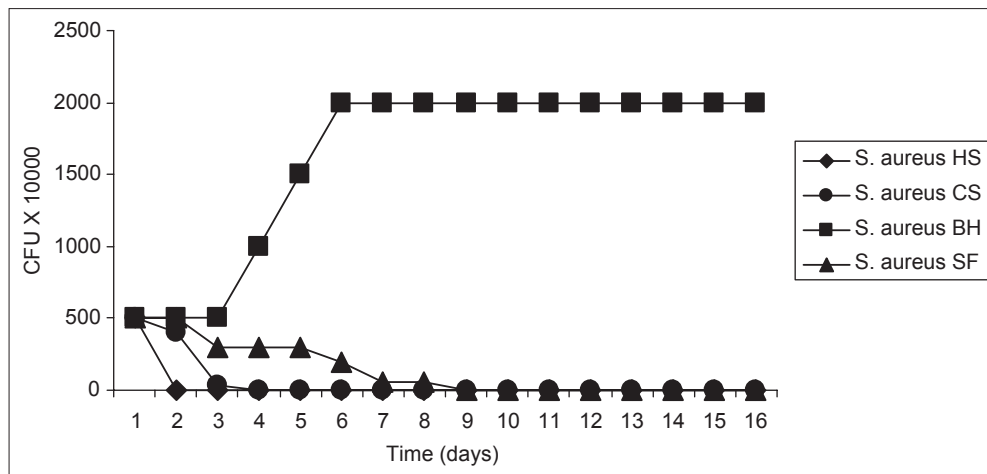


Figure 1: The growth of *S. aureus* in silicone oils and controls. HS: Heavy silicone, CS: Conventional silicone, BH: Brain-hearth broth, SF: Saline, SDB: Sabouraud dextroz broth

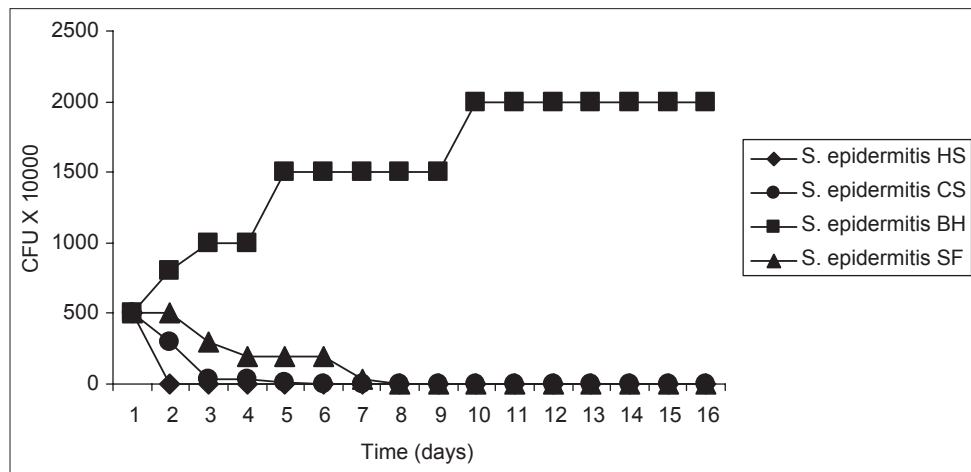


Figure 2: The growth of *S. epidermidis* in silicone oils and controls. HS: Heavy silicone, CS: Conventional silicone, BH: Brain-hearth broth, SF: Saline, SDB: Sabouraud dextroz broth

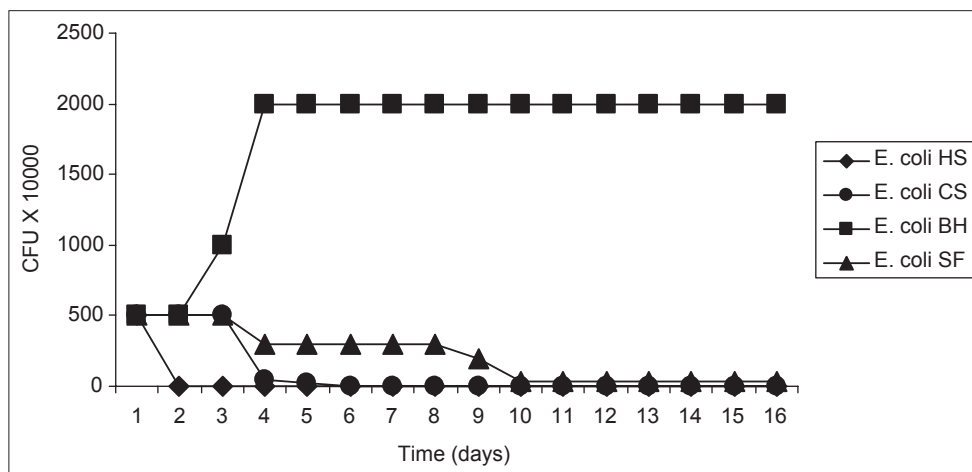


Figure 3: The growth of *E. coli* in silicone oils and controls. HS: Heavy silicone, CS: Conventional silicone, BH: Brain-hearth broth, SF: Saline, SDB: Sabouraud dextroz broth

Conventional silicone oil demonstrated a significant decrease in bacterial load at third day against *S. aureus*, at

first day against *S. epidermidis*, at fourth day against *E. coli*, at eighth day against *P. aeruginosa*, and these antibacterial effects

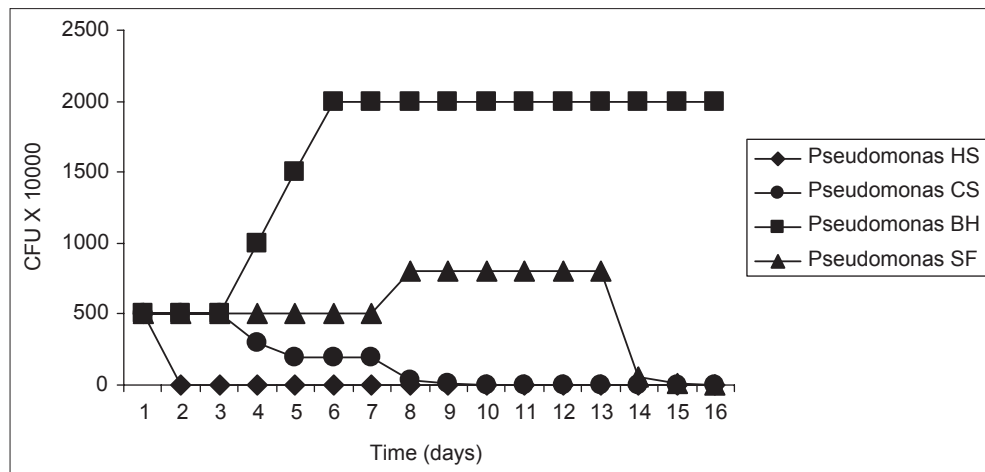


Figure 4: The growth of *P. aeruginosa* in silicone oils and controls. HS: Heavy silicone, CS: Conventional silicone, BH: Brain-hearth broth, SF: Saline, SDB: Sabouraud dextroz broth

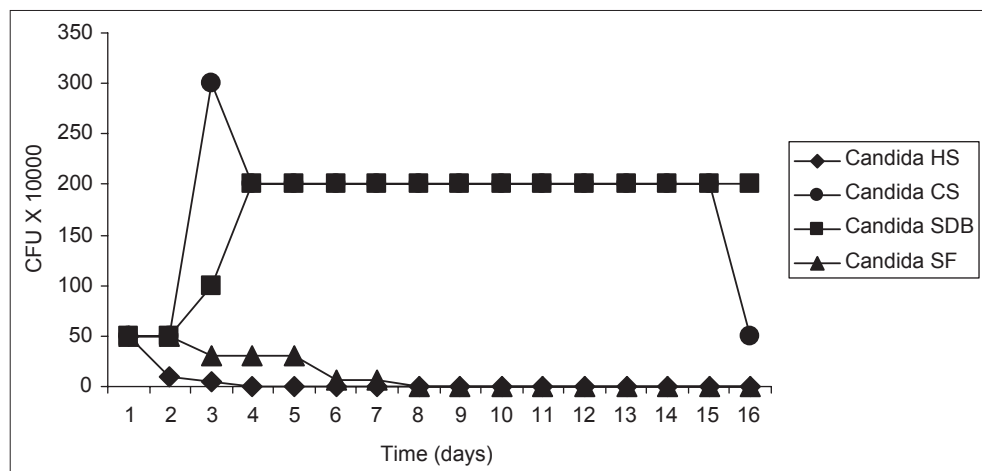


Figure 5: The growth of *C. albicans* in silicone oils and controls. HS: Heavy silicone, CS: Conventional silicone, BH: Brain-hearth broth, SF: Saline, SDB: Sabouraud dextroz broth

stayed same for 16 days. *Candida albicans* grew at third day significantly (300 CFU) and after a decrease of 100 CFU at fourth day, the colonies stayed stable up to 15 days.

In heavy silicone oil, the number of all microorganisms survived only 2 days, and then their numbers declined to zero levels at the end of second day and this effect remained the same up to 16 days. In controls, all pathogens grew rapidly in brain-heart infusion broth and Sabouraud Dextroz broth, while they decreased in saline.

Discussion

Endophthalmitis cases have been treated with several routes of antibiotic administration, including intravitreal, systemic, topical, and subconjunctival previously.^[6,7] With the advent of vitrectomy techniques, pars plana vitrectomy combined with intravitreal antibiotics became the standard treatment for all forms of endophthalmitis. Vitreoretinal surgeons have also used silicone oil in cases of endophthalmitis with extensive retinal damage as intraocular tamponade in order to prevent retinal detachment over the past two decades.^[8-10]

The potential antimicrobial properties of silicone oil *in vitro* have been reported in the literature.^[4,5] Özdamar *et al.*^[4]

have shown that conventional silicone oil had antimicrobial activity against endophthalmitis-causing agents like *S. aureus*, *S. epidermidis*, *P. aeruginosa*, and *C. albicans* in *in vitro* conditions. In our study, we compared the antimicrobial effectiveness of heavy silicone oil and conventional silicone oil against the endophthalmitis-causing microorganisms. Conventional silicone oil decreased the colony numbers of all bacteria except for *C. albicans*, but heavy silicone oil demonstrated a superior antimicrobial effect on all pathogens including *C. albicans*.

Although a mechanism of the antimicrobial effect of silicone oils has not yet been clearly determined, physical and chemical properties may help us to understand the bioactivity of this material.^[11] Being highly hydrophobic and having hydrogen bonding interactions, silicone oils might have damaged the cellular membrane of the infectious agents and improved the efficacy of human defence mechanisms.

Concurrent endophthalmitis and retinal detachment have a poor visual and anatomical outcome, especially when retinal detachment is an intraoperative complication.^[12-14] Therefore, vitrectomy with silicone oil tamponade may result in faster and better visual rehabilitation and reduced risk of retinal detachment and decrease the need for additional

procedures. The role of heavy silicone oil in the treatment of endophthalmitis cases may be assessed by a prospective study with larger amount of patients to confirm the findings of this study.

References

1. Lemley CA, Han DP. Endophthalmitis: A review of current evaluation and management. *Retina* 2007;27:662-80.
2. Berker N, Batman C, Ozdamar Y, Eranil S, Aslan O, Zilelioglu O. Long-term outcomes of heavy silicone oil tamponade for complicated retinal detachment. *Eur J Ophthalmol* 2007;17:797-803.
3. Wagenfeld L, Zeitz O, Skevas C, Richard G. Long-lasting endotamponades in vitreoretinal surgery. *Ophthalmologica* 2010;224:291-300.
4. Ozdamar A, Aras C, Ozturk R, Akin E, Karacorlu M, Ercikan C. *In vitro* antimicrobial activity of silicone oil against endophthalmitis-causing agents. *Retina* 1999;19:122-6.
5. Yan H, Li J. An experimental study on antimicrobial activity of silicone oil *in vitro*. *Ophthalmologica* 2008;222:245-8.
6. Baum J, Peyman GA, Barza M. Intravitreal administration of antibiotic in the treatment of bacterial endophthalmitis. III. Consensus. *Surv Ophthalmol* 1982;26:204-6.
7. Busbee BG. Endophthalmitis: A reappraisal of incidence and treatment. *Curr Opin Ophthalmol* 2006;17:286-91.
8. Bali E, Huyghe P, Caspers L, Libert J. Vitrectomy and silicone oil in the treatment of acute endophthalmitis. Preliminary results. *Bull Soc Belge Ophthalmol* 2003;288:9-14.
9. Results of the endophthalmitis vitrectomy study: A randomized trial of immediate vitrectomy and of intravenous antibiotics for the treatment of postoperative bacterial endophthalmitis. Endophthalmitis vitrectomy study group. *Arch Ophthalmol* 1995;113:1479-96.
10. Doft BM, Kelsey SF, Wisniewski SR. Retinal detachment in the Endophthalmitis Vitrectomy Study. *Arch Ophthalmol* 2000;118:1661-5.
11. Kim YM, Farrah S, Baney RH. Structure-antimicrobial activity relationship for silanols, a new class of disinfectants, compared with alcohols and phenols. *Int J Antimicrob Agents* 2007;29:217-22.
12. Aras C, Ozdamar A, Karacorlu M, Ozkan S. Silicone oil in the surgical treatment of endophthalmitis associated with retinal detachment. *Int Ophthalmol* 2001;24:147-50.
13. Foster RE, Rubsamen PE, Joondeph BC, Flynn HW Jr, Smiddy WS. Concurrent endophthalmitis and retinal detachment. *Ophthalmology* 1994;101:490-8.
14. Bhagat N, Nagori S, Zarbin M. Post-traumatic infectious endophthalmitis. *Surv Ophthalmol* 2011;56:214-51.

Cite this article as: Örnek N, Apan T, Oğurel R, Örnek K. Comparison of the antimicrobial effect of heavy silicone oil and conventional silicone oil against endophthalmitis-causing agents. *Indian J Ophthalmol* 2014;62:388-91.

Source of Support: Nil. **Conflict of Interest:** None declared.