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Histopathological findings in eyes after silicone oil injection* **

B. Kirchhof, U. Tavakolian, H. Paulmann, and K. Heimann
University of Cologne, Department of Ophthalmology, Vitreoretinal Surgery, Cologne, Federal Republic of Germany

Abstract. Eight eyes were examined histologically after silicone oil injection. Intraretinal deposits suggestive of silicone were not present in attached retinas, but were frequently observed in detached retinas when subretinal silicone occurred. This may possibly be due to defects in the horizontal conducting structures of the retina such as those occurring in persistent detachment with disorganization of the retina. Morphologically, the retina was essentially normal 3.5 years after the silicone injection. This observation contradicts the idea that silicone oil has a toxic effect.

Introduction

Since the animal experiments of Mukai and colleagues (Mukai 1971; Mukai et al. 1972, 1975) it has been suspected that silicone oil has a toxic effect on the retina. The lipophilic properties of this material may bring about damage to the neuronal membranes. This might also account for the reduction in vision after use of silicone oil. On the other hand, it has not been sufficiently stressed that silicone oil is only used in severely damaged eyes with very poor visual prognosis. The human eyes investigated morphologically and reported in the literature were treated without vitrectomy and always had a total detachment (Sugar 1976; Rentsch et al. 1978; Leaver et al. 1979; Kirchhof and Heiman 1982; Laroche et al. 1983; Ni et al. 1983; Stefani 1983).

So far, no one has demonstrated what happens to the silicone in the human eye. In the preparation for microscopy, it is dissolved by the alcohol and osmic acid. It has been generally accepted that optically empty spaces, such as shown in Figs. 1 and 2, are phagocytosed silicone. It is often hard to decide whether the "oil bubbles" are cell-bound or freely located in the tissue, an appearance that could be mimicked by dead silicone macrophages. In addition, "secondary spongious degeneration" of the retina due to hypoxia or traction appears the same when the typical protein-containing cyst contents are minimal (Fig. 3).

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Offprint requests to: B. Kirchhof, Augenklinik der Universität, Josef Stelzmannstr. 9, D-5000 Köln 41, Federal Republic of Germany

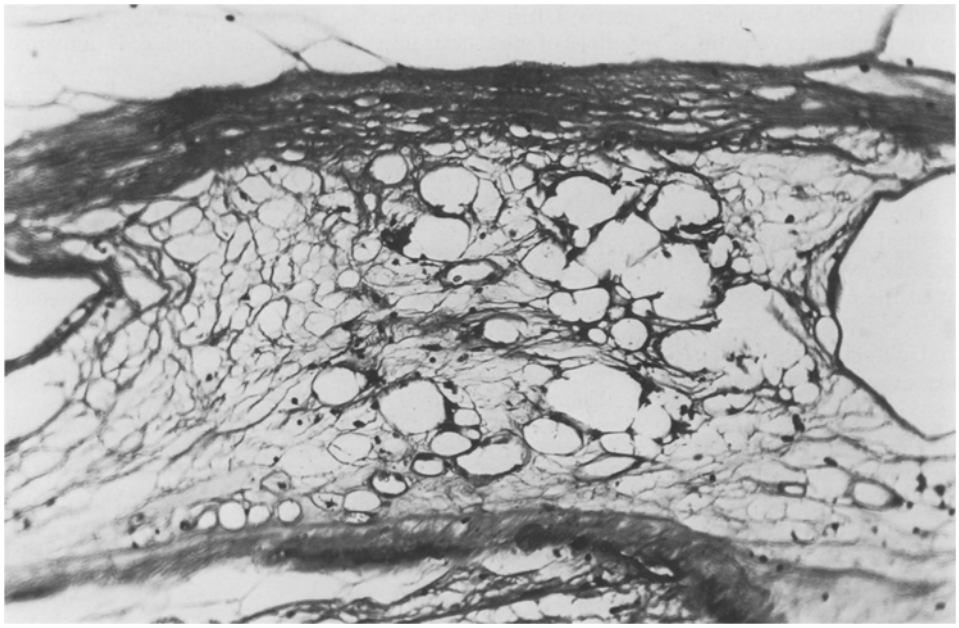

Fig. 1. Accumulation of macrophages in a zone of epiretinal fibrosis, optically empty spaces suggestive of silicone (×156)

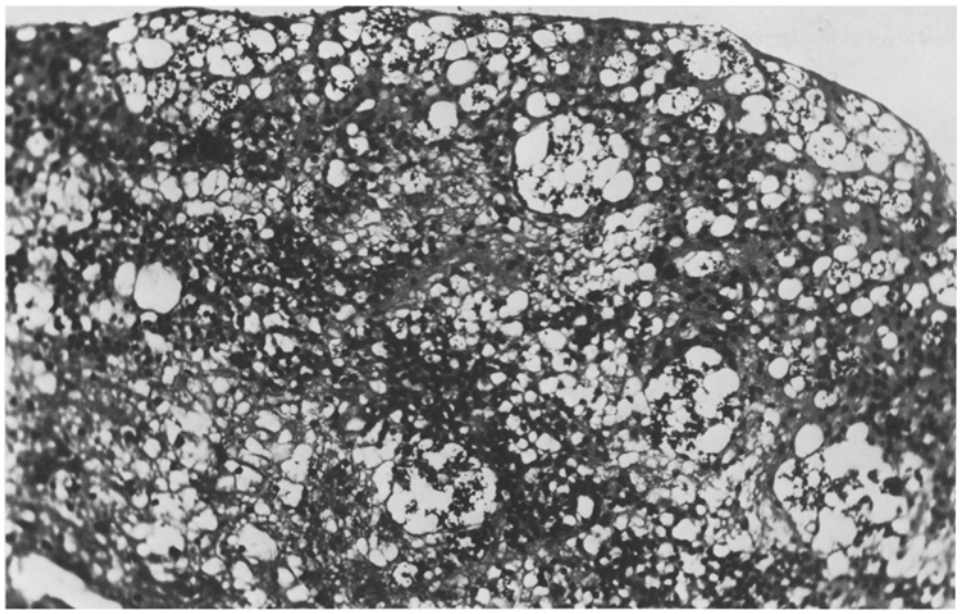

Fig. 2. Intraretinal deposits in detached retina suggestive of silicone (×160)

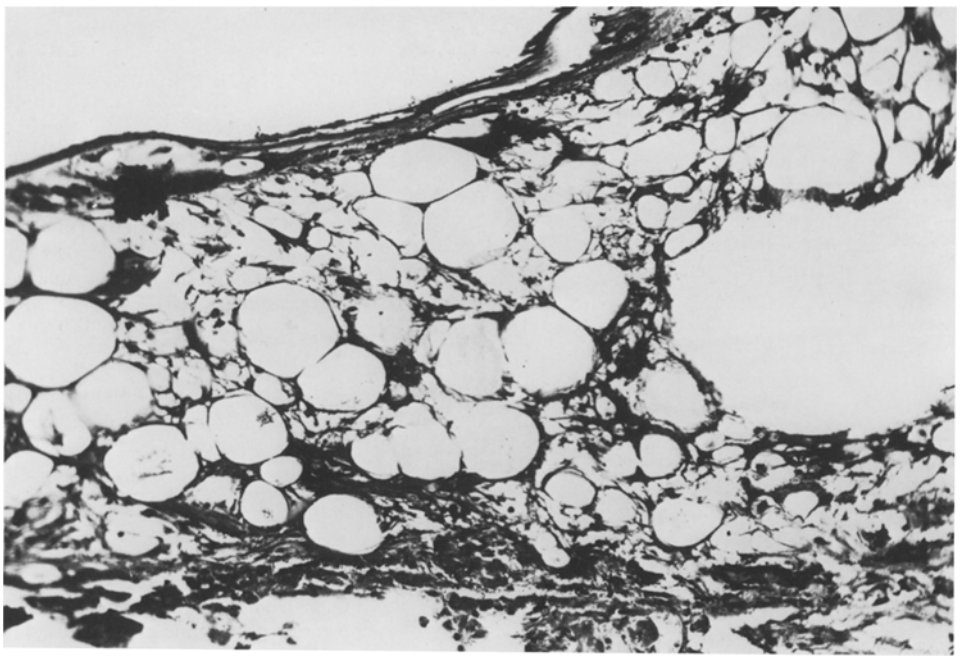

Fig. 3. "Secondary spongious degeneration." This eye had not received silicone (×173)

Table 1. Survey of deposits suggestive of silicone after silicone-injection for PVR detachment

Histolaboratory patient no.	Combined vitrectomy/ silicone injection	Years of silicone tamponade	Retina	Inclusions suggestive of silicone
W.F., 4554	Silicone-filling only	1.5	Partially detached; no subretinal silicone	Preretinal fibrosis
D.W., 4712	Yes	0.1	Attached	None
H.G., 4771	Unknown	Unknown	Detached; subretinal silicone	Retina, preretinal fibrosis, choroid
W.U., 4948	Silicone-filling only	1.0	Detached; subretinal silicone	Retina
G.A., 5113	Silicone-filling only	0.25	Detached; subretinal silicone	Subretinal fibrosis
K.G., 5137	Yes	3.5	Partially detached; subretinal silicone	Retina in detached areas only, iris stroma
S.H., 5302	Yes	0.7	Attached	Preretinal fibrosis
R.T., 5305	Yes	2.5	Detached; subretinal silicone	Retina

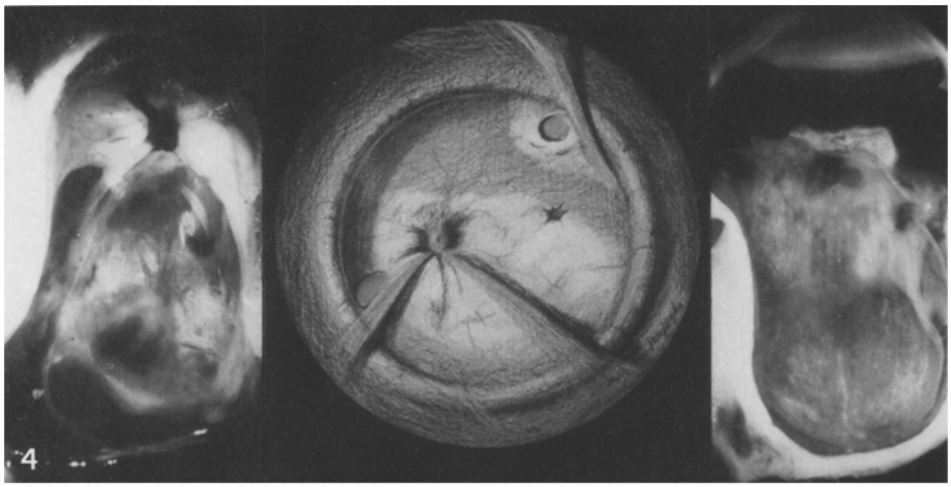

Fig. 4. Photomacrograph of the upper (*right*) and lower (*left*) half of the globe; sketch of the fundus (in between); K.G. 5137 (See Table 1, left eye)

Fig. 5. Details of the attached nasal retina over the buckle (same eye as Fig. 4). Subretinal fibrosis (*arrow*), artificial detachment due to processing (× 100)

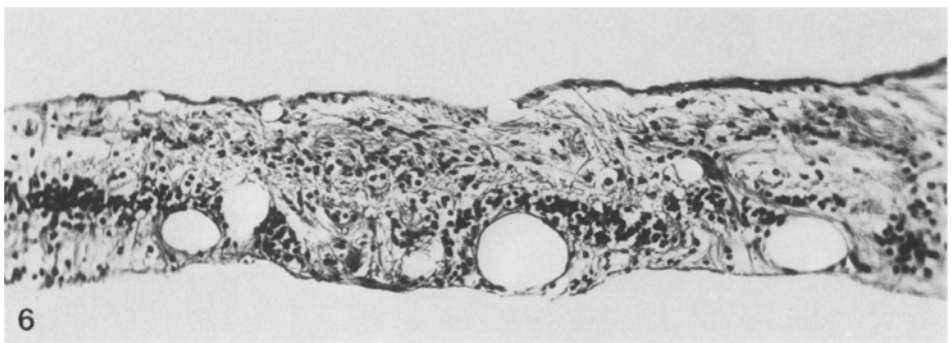

Fig. 6. Details of the detached posterior pole (same eye as Figs. 4 and 5) (× 100)

Patients and methods

We examined eight human eyes after silicone oil injection for the presence of intraretinal deposits suggestive of silicone. Most of them had previously been treated in our clinic, but some were referred to us by other hospitals. The specimens were processed according to the routine paraffin technique, and hydrated sections were stained with (1) hematoxylin and eosin and (2) periodic acid-Schiff (PAS) reaction. In four eyes vitrectomy was used in combination with the silicone injections; in one case, the surgical technique was unknown.

Results

Suspicious inclusions were not present in attached retina, but were frequently observed in detached retina with damaged horizontal conducting structures, such as the middle and outer limiting membranes, and silicone was found under the retina (Table 1). We should like to present three cases as examples.

In the first case (K.G. 5137, see Table 1), the retina was only partially detached. The fact that silicone oil behaves differently in attached and detached retinas could be seen in the same eye. The silicone injection in combination with vitrectomy was carried out 1 month after perforation by a gunshot. After 3.5 years later, the eye had ambulatory vision but was enucleated for cosmetic reasons, since it revealed a bullous keratopathy.

Microscopically, the retina was attached above and nasally, but temporally there was a strand of epiretinal fibrosis with a retinal hole and subretinal silicone. Inferonasally, in the posterior pole there was a large hole with epiretinal membrane traction (Fig. 4). The silicone oil passed through

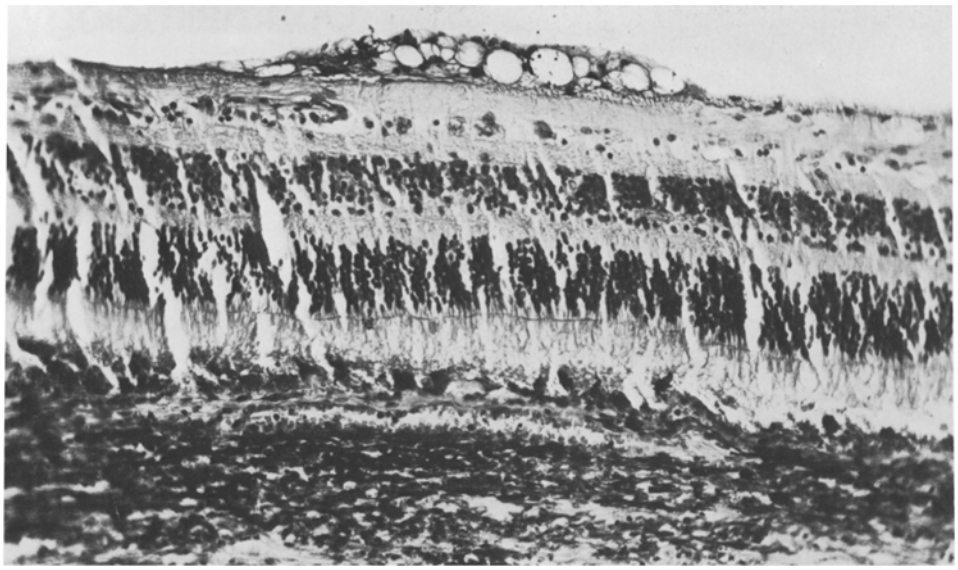

Fig. 7. Attached retina, suspected silicone macrophages in an epiretinal fibrosis, no suggestions of intra- or subretinal silicone (S.H. 5302), see Table 1 (×160)

the hole into the subretinal space. The entire posterior pole of the retina was shallowly detached (Fig. 6). The histology of the attached nasal retina over the buckle showed that layering was preserved (Fig. 5). The pleating to the internal limiting membrane, the gliosis of the nerve fiber layer, and the reduction of the ganglion cells did not exceed the extent that would be expected in proliferative vitreoretinopathy (PVR) – even without silicone oil injection. Optically empty spaces suggestive of silicone were not present in the attached retina (Fig. 5). In the area of the detached posterior pole the retina showed advanced disorganization and the horizontal conducting structures were destroyed. Here, optically empty cavities were present that were suggestive of silicone oil inclusions (Fig. 6).

In the second case, 8.5 months after combined vitrectomy and silicone injection, the eye was enucleated because of ischemic scleral necrosis due to the buckle (S.H. 5302, see Table 1). Light microscopy showed that the retina was attached and there were no suggestions of intra- or subretinal silicone (Fig. 7).

The last case (W.F. 4554, see Table 1) had intraocular silicone for 1.5 years before enucleation for secondary angle-closure glaucoma. At the time of silicone oil injection, vitrectomy was not being used in combination with silicone injection and thus a complete silicone fill was not accomplished. Light microscopy revealed advanced retinal degeneration due to partial persistent detachment. A special feature is that silicone had not passed behind the retina, and no silicone inclusions occurred in the detached retina.

Discussion

Histological examination of eight human bulbi had the following results. We found inclusions suggestive of silicone where silicone had passed beneath the retina, and the horizontal conducting structures of the detached retina were destroyed. We did not find any inclusions suggesting silicone oil where the retina was attached or where subretinal silicone did not occur. The intraretinal inclusions of silicone oil presumed appeared only in detached retinas.

On the basis of our findings, we suspect that the silicone oil passes from the subretinal space into the retina and is possibly carried by macrophages. This may be due to defects in the outer and middle limiting membranes, such as those occurring in persistent detachment with disorganization of the retina (H.G. 4771, W.K. 4948, K.G. 5137, R.T. 5305; see Table 1). From the morphological point of view, the observation that the retina was essentially normal 3.5 years after silicone contradicts the notion that silicone oil has a toxic action.

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