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The Various Complications Associated with Use of Silicone Oil in Rhegmatogenous Retinal Detachment (RRD) Surgery via Three-Port Vitrectomy (3PV): A Retrospective Study at the Ophthalmology Center of Abass Ndao Hospital

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Abstract

Introduction: RRD (Rhegmatogenous Retinal Detachment) is a separation between the neuroepithelium and the pigment epithelium due to the passage of fluid through a retinal dehiscence. It constitutes a major ophthalmologic emergency. Its management is primarily surgical, either through external or internal approaches, with tamponade using gas or silicone oil. The purpose of this study was to report the various complications associated with the use of silicone oil in vitreoretinal surgery. **Patients et methods:** We conducted a retrospective, descriptive, and analytical study from October 1, 2020, to October 31, 2023, which included all patients who underwent surgery for RRD using three-port vitrectomy (3PV) with tamponade using 1000 centistoke silicone oil (Group 1) and 5000 centistoke silicone oil (Group 2). All patients underwent a complete ophthalmologic examination and were operated on by the same surgeon. Data analysis was performed using Excel software. **Results:** Overall, 31 patient files representing 33 eyes were collected, with a mean age of 48.83 years and a sex ratio of 4.16. Group 1 consisted of 16 eyes (48.48%), and Group 2 consisted of 17 eyes (51.51%). The different complications observed were cataracts in all phakic subjects, accounting for 57.57%; ocular hypertonia in 69.69% (27.27% in Group 1; 42.42% in Group 2); anterior chamber silicone oil migration in 24.24% (9.09% in Group 1; 15.15% in Group 2); recurrence of retinal detachment in 21.21% (6.06% in Group 1; 15.15% in Group 2); and silicone oil emulsification in 24.24% (15.15% in Group 1; 9.09% in Group 2). Additionally, there was one case of corneal degeneration in Group 1. **Conclusion:** Silicone oil is an effective tamponade

agent used in the treatment of retinal detachments. Close patient follow-up is necessary due to the complications associated with its use, which can occur either early or late after surgery.

Keywords

Silicone, Cataracts, OHT, Emulsifications

1. Introduction

RRD (Rhegmatogenous Retinal Detachment) is a separation between the neuroepithelium and the pigment epithelium due to the passage of fluid through a retinal dehiscence [1]. It constitutes a major ophthalmologic emergency and is a secondary cause of blindness [2]. In Senegal, RRD accounts for 38.8% of monophthalmic cases, surpassing traumas [3]. Its management is primarily surgical through external or internal approaches (3PV) with tamponade using gas or silicone oil. Silicone oil is an effective tamponade agent used in the treatment of severe retinal detachments (RD). Its viscosities range from 1000 to 5700 centistokes (cSt), but their surface tension and reapplication properties are nearly identical. Silicone oil tamponade is a constant volume tamponade. Its transparency allows for rapid visual recovery, easy retinal monitoring, and, if necessary, postoperative photocoagulation. Silicone oil removal is typically performed after several months. A second surgery is required [4]. Close monitoring is necessary as it leads to complications that can be either early (increased intraocular pressure or anterior segment inflammation) or late (cataract, silicone oil emulsification, pressure changes, keratopathy, or RD recurrence) [4]. The aim of this study was to report the various complications associated with the use of silicone oil in vitreoretinal surgery at the Ophthalmology Center of Abass Ndao Hospital.

2. Patients et Methods

We conducted a retrospective, descriptive, and analytical study from October 1, 2020, to October 31, 2023, at the Ophthalmology Center of Abass Ndao Hospital in Dakar. The study included all patient records who underwent surgery for rhegmatogenous retinal detachment (RRD) via three-port vitrectomy (3PV) with tamponade using 1000 centistokes silicone oil (Group 1) and 5000 centistokes silicone oil (Group 2). Patients who underwent external approach surgery for RRD and those who underwent internal approach surgery with gas tamponade were excluded. All patients underwent a comprehensive ophthalmic examination conducted by at least two specialist physicians and were operated on by the same surgeon. Surgery was performed using the Stellaris PC system from Bausch and Lomb and 23-gauge posterior vitrectomy packs. Postoperative follow-up was a minimum of 6 months. We developed a data collection form for gathering information from interviews, clinical and paraclinical examinations, treatment

details, and outcome measures. Data analysis was conducted using Excel 2016.

3. Results

Overall, 31 patient files representing 33 eyes were collected, with a mean age of 48.83 years and a sex ratio of 4.16. Group 1 (G1) included 16 eyes (48.48%), and Group 2 (G2) included 17 eyes (51.51%). The different complications observed (Table 1, Figure 1) were cataracts (Figure 2(a)) in all phakic subjects, accounting for 57.57%; ocular hypertonia (OHT) in 69.69% (27.27% in G1; 42.42% in G2); anterior chamber silicone oil migration (Figure 2) in 24.24% (9.09% in G1; 15.15% in G2); recurrence of retinal detachment (RRD) in 21.21% (6.06% in G1; 15.15% in G2); silicone oil emulsification in 24.24% (15.15% in G1; 9.09% in G2); and one case of corneal degeneration in G1.

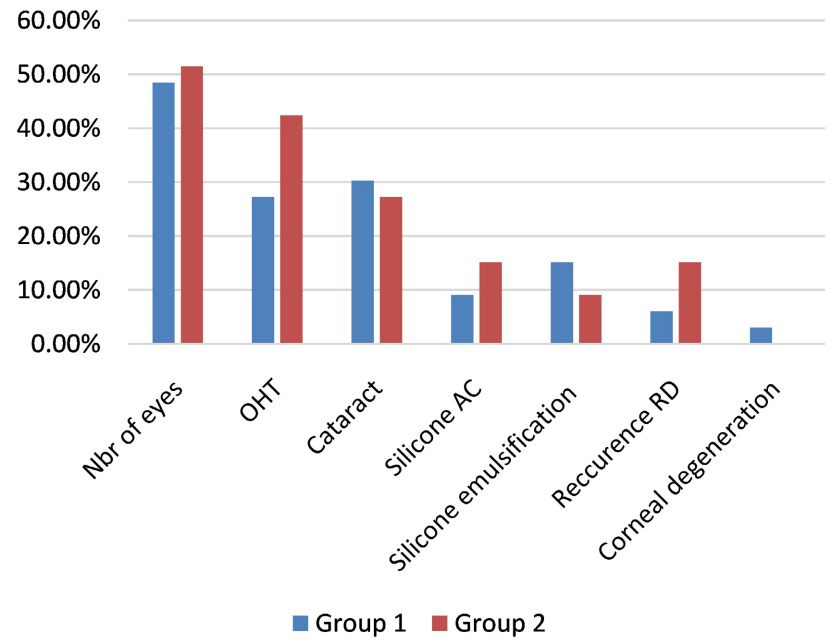

Figure 1. The different complications found.

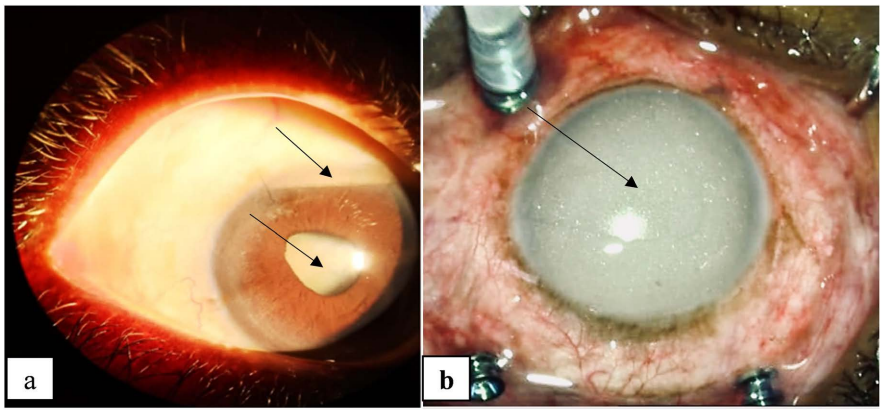

Figure 2. Hyperoleon associated with cataract (a); silicone oil emulsification image during intraoperative removal (b).

Table 1. The different complications found.

	G1	G2	Total
Number of eyes	48.50%	51.50%	100%
OHT	27.27%	42.42%	69.69%
Cataract	30.30%	27.27%	57.57%
Silicone AC	9.09%	15.15%	24.24%
Silicone emulsification	15.15%	9.09%	24.24%
Recurrence of RD	6.06%	15.15%	21.21%
Corneal degeneration	3.03%	0	3.03%

4. Discussion

Silicone oil is an effective tamponade agent used in the treatment of severe retinal detachments. Complications related to its use have been well-documented, highlighting the importance of close patient follow-up. These complications can be either early or late and arise from contact with various intraocular tissues [4].

Postoperative ocular hypertonia (OHT) can be due to pupillary block [5], overfilling, or silicone emulsification blocking the trabecular meshwork [6]. In our series, it was noted in 69.69% of cases, more frequently in group 2, the same for Dilek's study [7] which had a high OHT rate with 5000 cst silicone oil. Could heavy silicone oil be more likely to cause ocular hypertonia? In various studies, the incidence varies between 12% and 70% [8] [9]. Bouazza *et al.* reported a lower rate of 10.9% [9]. To prevent angle-closure glaucoma related to pupillary block in aphakic or pseudophakic patients, peripheral iridectomy should be performed within 6 hours. If heavy silicone oil is used, it should be performed after 12 hours [4].

Cataract is the most frequent complication, potentially related to the surgery itself or the presence of intraocular silicone. It affects 38% to 100% of patients depending on the series and appears to be systematic when heavy silicone oil is used [11] [12]. Among pseudophakic patients, posterior capsular fibrosis is often found. Its pathophysiology may involve metabolic exchanges or mechanically [13] due to the irritation of the posterior capsule [12], an infiltration of crystalline epithelial layers is also described [14]. In our series, postoperative cataract was found in all phakic patients. Dilek [7] also reported a similar frequency of cataract occurrence regardless of the type of silicone used. Internal tamponade appears to accelerate the progression to cataract formation. Cataract surgery is performed concurrently with silicone oil removal [10].

Emulsification and migration of silicone into the anterior chamber AC is the second most frequent complication [12]. There is a process of fragmentation of the initial silicone bubble into multiple smaller bubbles, which diminishes its tamponade capability. Emulsified microbubbles migrate to the anterior chamber (AC) and trabecular meshwork, leading to decreased visual acuity, keratopathy, or ocular hypertension [4]. In our series, the rate of emulsification was higher in

group 1; whereas silicone passage into the AC was more prevalent in group 2. Silicone viscosity ≤ 1000 cSt poses a higher risk of emulsification [4]. In aphakic or pseudophakic patients, silicone passage into the AC is more frequently observed and may be associated with zonular dehiscence or posterior capsulotomy [15].

Silicone-related keratopathy arises from direct contact between silicone, whether emulsified or not, and endothelial cells. In the literature, its incidence ranges from 5.5% to 7% of cases [16] in our series, it was found in 3.03% of cases. Its occurrence increases with the duration of internal tamponade and typically begins with corneal thinning accompanied by opacity. Ulceration or band-shaped keratopathy are possible manifestations, but the cornea usually remains clear and becomes fully opaque following silicone removal [4].

The recurrence rate of retinal detachment under silicone oil varies across studies. Riedel *et al.* Reported a recurrence rate 40% [16], Duan *et al.* reported 12.1% [11], in our series the recurrence rate was de 21.21%. Recurrence can be attributed to inadequate surgical treatment, including incomplete vitrectomy or retinopexy without sufficient indentation if necessary [17]. In most cases, recurrences are associated with severe proliferative vitreoretinopathy (PVR) characterized by the extensive formation of fibrovascular tractional tissues. The origin of these tissues remains debated, whether an extension of preoperative PVR [11] or induced by a contact with silicone oil [18]. Microbubbles of silicone and associated inflammatory reactions have been observed within these membranes [19].

Other complications have been described [4]; including postoperative inflammation which may also be related to the surgery itself. Refractive errors are notable; silicone can induce hyperopia of 3 to 7 diopters in phakic patients and myopia of 5 diopters in aphakic patients. These changes are not strictly complications but rather transient disturbances that persist only during the intraocular presence of silicone. Sticky silicone phenomena occur during silicone oil removal, where the bubble does not remain cohesive but fragments and adheres to intraocular structures. Small, flat sheets of silicone are distributed as patches at the posterior pole or on the posterior capsule and intraocular carried out implants in cases of posterior capsulotomy. This phenomenon is described as sticky silicone.

The main limitation of our study is its retrospective nature with an unequal number of patients between the two groups. Additionally, the indications for different types of silicone were sometimes not strictly followed due to the limited availability of the oil used.

5. Conclusion

Complications related to the use of silicone oil in vitreoretinal surgery are generally temporary and benefit from appropriate management, whether medical or surgical. Furthermore, despite any complications arising from silicone oil use, the overall benefit to the patient is significant. In our study, complications were more frequent with 5000 centistokes silicone oil. Cataract formation was the

most common complication, and emulsification was more frequent with 1000 centistokes silicone oil. Silicone oil is an efficient tamponade used in retinal detachment treatment. Close monitoring of patients is necessary due to the complications associated with its use. These can be early or late complications, resulting from its contact with various intraocular tissues. Therefore, postoperative follow-up must be rigorous and prolonged to minimize the risk of sequels.

Finance

This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

Ethical Considerations

The collection of data on patients' files was carried out with strict compliance with medical confidentiality.

Conflicts of Interest

Authors declared that there was no conflict of interest.

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