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CASE REPORT

Case Report: Acute Retinal Necrosis following Unexpanded Gas Tamponade Acute Retinal Necrosis following Unexpanded Gas Tamponade

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Abstract:

Purpose:

To present 2 cases of acute non-hemorrhagic retinal necrosis occurring following pars plana vitrectomy for epiretinal membrane peeling following the use of unexpanded gas tamponade.

Case Report:

Two eyes (both right eyes) of 2 healthy females presented with decreased visual acuity due to Epiretinal membrane, and they underwent 25G vitrectomy and membrane peeling. The vitrectomy operation was uneventful and was concluded with the insertion of 20% sulfur hexafluoride (SF6) tamponade. Both eyes were pseudophakic and had no other ocular or systemic pathology. Patients were controlled 24 hours following the surgery and both presented with normal anterior segment examination and normal intraocular pressure. Both patients complained of central scotoma and both had very difficult light perception. Fundus examination showed devitalized macula structures in the presence of gas bubbles occupying almost 100% of the vitreous cavity. OCT examination done a few days after surgery revealed necrotic retinal tissue. Four weeks later, both eyes had light perception vision, and devitalization of the central macula and spicule-like pigment changes in the midperiphery of the retinal in both eyes.

Conclusion:

We present 2 cases of blindness after vitrectomy with ILM peeling combined with 20% SF6 Intraocular tamponade. This severe complication was not related to elevated intraocular pressure due to gas expansion.

Keywords: Case report, Vitrectomy, Retinal necrosis, Blindness, Intraocular tamponade, Eye surgery.

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1. INTRODUCTION

Ocular endotamponades include perfluorocarbon liquids, silicone oils and expandable gases, which are all used intraoperatively either as a manipulating device or as short- or long-term tamponade [1].

During the past half century, the widespread use of gases in eye surgery as an intraocular tamponade for retinal detachment and macular hole surgeries was universal [1, 2]. Pure fluorinated gases, especially sulfur hexafluoride (SF6) and perfluoropropane (C3F8), were generally used due to their expansile properties during pneumatic retinopexy but when diluted with sterile air in no expansile fractions, they could be used to fill the vitreous cavity achieving long-duration retinal tamponade in vitrectomy operations. A series of severe ocular toxicity events have occurred since 2013, causing hundreds of cases of irreversible blindness. The use of perfluorocarbon liquids, however, in combination with substances used in vitreoretinal surgery (*e.g*., internal limiting membrane dyes, Triamcinolone and silicone oils) could have aggravated the problem [2]. Perfluorocarbon liquids were introduced as retinal manipulators [3] in 1990, but they could not remain inside the eye long after surgery as they provoke an inflammatory reaction inside the eye [4, 5].

Cases of blindness following the correct use of AlaOcta®, a perfluorocarbon (Alamedics GmbH, Dornstadt, Germany), were among those cases [6], in addition to those reported from Bio-Octane Plus® (Biotech Ophthalmic PVT Ltd., Ahmadabad, India) [7]. This is among several publications

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particularly concerning Perfluorocarbon liquids and addressing the acute toxic effect [8 - 10]. In addition to that, it is clear that certain complications could happen after surgery due to multifactorial reasons [11].

The incidence of unexplained visual loss after gas tamponade retinal detachment surgery is very low, which unfortunately leads to permanent visual loss [12]. Severe retinal necrosis could happen following the use of SF6 gas, which could lead to retinal necrosis and irreversible retinal damage if malignant glaucoma occurs [13].

In this case report, we present 2 cases of irreversible blindness probably due to severe toxicity of intraocular 20% SF6 gas tamponade in an uncomplicated Vitrectomy procedure with elevated intraocular pressure.

2. CASE REPORT

62 and 64-year-old healthy female patients underwent 25-G vitretectomy under local anesthesia using a bupivacaine retrobulbar block and intravenous sedation. Both eyes had a normal ophthalmological examination, and both were pseudophakic and had normal deep anterior chamber and normal capsular complex anatomy.

The 25-G vitrectomy was uneventful. At the end of the surgery and following the removal of the epiretinal membrane, air/fluid exchange was performed, followed by the insertion of 20% SF6 gas. The circulating nurse drew up 10 cc pure SF6 gas (Alcon SF6 Gas 125 gram Tank, Alcon Constellation console, Alcon, Inc, Fort Worth, TX) on a 50-cc syringe, which was then diluted with 40 cc air through a millipore filter and was exchanged with vitreous chamber air through a fluted needle.

The self-sealing sclerotomies required no stitches after the removal of the trocars and eye pressure was checked manually to be within normal at the end of the surgery.

Patients were discharged and instructed to stay in the prone position. Postoperatively, as the patient initially showed normal recovery, they were discharged from the one-day surgery department in the afternoon to be followed up the next morning. Patients were instructed to maintain the prone position postoperatively. On the next morning, both patients presented with central scotoma and light perception. Anterior segment examination showed normal findings and complex anatomically correctly positioned intraocular lens-capsule. Intraocular pressure was measured and was within normal values. Fundus examination showed a complete gas bubble occupying the vitreous chamber, and the macula was being devitalized. OCT examination showed necrotic retinal tissue and loss of macular structures. Four weeks postoperatively, both eyes showed no improvement and still have light perception vision. The ocular examination was normal except for the necrotic devitalized macula and spicule-like pigment changes in the midperiphery of the retinal in both eyes. Intraocular pressure was never elevated during the post-operative period. No iris atrophy was observed, and severe atrophic and devitalized retina and choroid were observed with markedly attenuated vessels and paled the optic disk. The fellow eyes examination was normal, with a best distant corrected visual acuity of 1.0 decimal values and normal ophthalmic examination and normal intraocular pressure.

3. RESULTS AND DISCUSSION

Norton's proposed in 1973 the use of SF6 gas as a longer acting tamponade in vitreoretinal surgery [14]. Nowadays, it has become a routine step in retinal and macular surgery. The long-term retinal tamponade was achieved by moving the nitrogen and other tissue gases into a vitreous gas bubble within the first 48 to 96 hours, with relatively slow diffusion of fluorinated gas into the body continuing over approximately 7 to 10 days for SF6 or 5 weeks for C3F8 [15]. During the early usage of fluorinated gases, major ischemic events occurred. Abrams *et al*. reported in a series of 101 consecutive PPV procedures using sulfur hexafluoride in 1978 that 10 eyes developed during the first 24 hours, an elevation of the intraocular pressure, no light perception, and presumed central retinal artery occlusion. Most of the eyes received pure or concentrated gas after the withdrawal of BSS liquid at the end of the procedure [16]. Today, fluorinated gases must be diluted before use. The gas concentration commonly in use today is relatively no expansile, which has led to major improvement in results and has decreased massively gas-related complications. In addition to the normal theoretical complication, a number of unexplained events occurred related to gas tamponade [17].

Today, the majority of retinal surgeons would do a "full fill" with SF6 or C3F8 that has been either commercially already prepared diluted products fractionated with sterile air. Others prefer to have the concentration done shortly before the use of those gases by having such no expansile concentrations of fluorinated gas made by their surgical team technicians.

In the 1970s, SF6 experiments on owl monkeys found that when more than 50% of the vitreous cavity is filled with pure SF6 or when a complete fill of SF6/ air mixture exceeds 50% SF6, an increase in intraocular pressure predictably occurs within the first 24 hours of injection [18]. Another study in which the intraocular pressure was artificially elevated for 8 continuous hours in an owl monkey observed necrosis of nearly all intraocular structures in a pattern almost indistinguishable from our case [19]. In 1982, Gass and Parrish reported a case of vision loss after phacoemulsification associated with infarction of the outer retina and pigment epithelium [20]. The authors attributed the complication to a sustained increased intraocular pressure from either a defective phacoemulsification device or, more likely, from an intraocular volume-reducing device applied to the eye preoperatively. This damage was replicated in owl monkey eyes by elevating the intraocular pressure above systolic blood pressure for 90 or 120 minutes [21]. A characteristic pattern of mottled hyperpigmentation and depigmentation [12, 13] developed 2 to 5 weeks later and is strikingly similar to our patients' findings appearing a few weeks after surgery. It remains a great concern facing a complication like blindness due to postoperative ischemic events related to the use of fluorinated gas tamponade.

The incidence of such postoperative ischemic events such as ischemic optic neuropathy, central retinal artery occlusion, or central retinal vein occlusion, with significant vision loss in the first 72 hours postoperatively, is about 0.06 events per year of practice, or between 1 and 2 events for every 20 years of practice [22]. Because knowledge of the maximum safe fraction of gas with complete gas fill is widespread among vitreoretinal surgeons, these events are more likely secondary to technique deviations, such as injection of an inadvertently high gas concentration. This is not always the case because gas expansion could also happen even under the correct nonexpendable concentrations. Rooney *et al*. discussed in their report the occurrence of retinal necrosis following elevated intraocular pressure following a vitrectomy procedure, but SF6 was correctly diluted to 20% [13]. SF6 tamponade, in a 20% concentration, is very commonly used in vitreoretinal surgery without vision-threatening complications postoperatively. Although expansile gas tamponade is the major cause of such complication [22, 23], a multifactorial element here would contribute to the incidence of such complications and could have aggravated the results [11].

The incidence of unexplained visual loss after gas tamponade retinal detachment surgery is very low and, in fact, could lead to irreversible axonal damage within retinal ganglion cells

resulting in permanent visual loss. Lorenzo *et al*. did not find the reason for this unexplained complication, but they attributed it to the use of gas [12]. Severe retinal necrosis could happen following the use of SF6 gas and lead to retinal necrosis and irreversible retinal damage if malignant glaucoma occurs [13].

In our case report, an expansile gas tamponade phenomenon giving rise to acute glaucoma that ultimately ended in blindness did not occur. The patients presented on the first postoperative day for the routine vitrectomy examination, anterior segment examination was normal with no displacement of the lens-capsule complex forward by the gas bubble, normal depth anterior, posterior chambers and no elevation in the intraocular pressure. Finally, the massive ischemic destruction of intraocular structures and the necrosis of the retinal layers could be attributed to the toxic gas effect.

CONCLUSION

The use of intraocular gases can result in postoperative intraocular severe complications even if correctly diluted. Among the different complications such as pressure elevation, malignant glaucoma, cataract formation, gas migration, and temporary vision impairment, now we are facing a retinal necrosis event. Lately, vitrectomy procedures for uncomplicated retinal detachments have shown an attempt to shift from expandable gases towards the air. For such a reason, we recommend the shift from gas towards the air in simple macular surgery procedures such as membrane peeling

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

Not applicable.

CONSENT FOR PUBLICATION

Informed consent was obtained from the participants.

STANDARDS OF REPORTING

CARE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

Not applicable.

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CONFLICT OF INTEREST

The authors report no conflict of interest. The authors alone are responsible for the content and writing of the paper.

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