Surgical Technique

Sandwich technique using a combination of perfluoropropane and silicone oil for inferior retinal detachment

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We report a novel surgical sandwich technique using a combination of intraocular perfluoropropane (C_3F_8) and silicone oil for inferior retinal detachment (RD). After conventional pars plana vitrectomy and posterior vitreous detachment induction, fluid-gas exchange using 14% C_3F_8 was done. This was followed by silicone oil injection using automated infusion pump to 50% fill of the vitreous cavity under direct visualization to achieve formation of two bubbles – gas bubble superiorly and silicone oil inferiorly. The patient was subsequently asked to maintain upright position. The two immiscible bubbles of C_3F_8 and silicone oil provide tamponade to superior and inferior retina, respectively. With time, gas bubble reduces in size with a gradual superior shift of silicone oil. This novel sandwich technique achieves complete attachment of retina and reduces the risk of retinal redetachment in inferior RDs by adequately tamponading the inferior retina.

Key words: Inferior retinal detachment, perfluoropropane, proliferative vitreoretinopathy, sandwich technique, silicone oil

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Despite the various advances in vitreoretinal surgery in the last few decades, still, one of the commonly encountered difficulties is the recurrence of retinal detachment (RD) due to reopening of breaks or proliferative changes in the inferior retinal periphery. The standard gas or silicone oil endotamponades are unable to provide adequate retinal support in the inferior retina without adequate posturing.[1,2] Moreover, maintaining prone position remains a challenge, especially in old age or patients with known spinal disorder. Both silicone oil (0.97 g/mL) and intraocular gases (0.001 g/mL) have a lower specific gravity as compared to vitreous (1.005–1.008 g/mL), as a result of which, they tend to float in the vitreous cavity. Therefore, the inferior retina is poorly supported by these tamponading agents and is more prone to the development of proliferative vitreoretinopathy (PVR) changes.[3,4]

The introduction of heavier-than-water tamponades in the form of fluorinated silicone oil, perfluorocarbon liquids (PFCLs), partially fluorinated alkanes (PFAs), and heavy silicone oils (HSOs) has tried to circumvent this lacuna. However, associated challenges including potential retinal toxicity with PFCL, higher rates of emulsification, and intraocular pressure rise with fluorinated silicone oil, PFA, or HSO along with nonsuperior results compared to silicone oil have prevented their common usage.[5-8] Double filling with fluorinated silicone oil and conventional silicone oil or PFA and conventional silicone oil have also been attempted with not so encouraging results with issues such as miscibility of fluids and similar recurrence rates of RDs.[9,10]

We have tried a different combination of using C_3F_8 gas and conventional silicone oil (1000 cs) which would provide an adequate tamponade to both the superior and inferior retina alike and probably reduce the incidence of PVR changes.

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Conventional 23G or 25G vitrectomy was performed. Posterior vitreous detachment induction was done if not already present along with peripheral vitrectomy. Once vitrectomy was complete, fluid-air exchange was then performed and remaining subretinal fluid removed through the retinal break or drainage retinotomy. To achieve an isoexpansile concentration, 14% C_3F_8 was then injected [Fig. 1a]. This was followed by slow injection of silicone oil to cover half of the vitreous cavity up to the level of equator using an automated infusion pump using a endoilluminator [Video 1]. Postoperatively, the patient maintained upright position. Intraocular gas C_3F_8, having a specific gravity lesser than oil, will remain above the gas–oil interface and further push on the oil inferiorly so as to maintain

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the inferior retinal tamponade [Fig. 1b]. A representative case is described as shown in Fig. 2. Table 1 shows the details of patients who underwent RD repair using sandwich technique.

Discussion

With the currently used tamponades such as intraocular gas (C_3F_8) and silicone oil or newer agents, recurrent RD occurs in view of inadequate, inferior retinal support.[1-8] The above-described sandwich technique leads to the formation of two bubbles – gas bubble superiorly and silicone oil inferiorly. This technique will essentially provide support to both superior and inferior retina, unlike conventional silicone oil and gas tamponades which predominantly provide support to the superior retina only. The gas and silicone oil component remain immiscible unlike the combination of silicone oil and HSO. The injected gas C_3F_8 has higher buoyancy compared to silicone oil. For instance, the net upward force acting on a gas bubble of C_3F_8 (1 ml weighing 0.001 g) which displaces 1 ml of fluid, i.e. 1 g, will be 0.999 g. This upward force which is much higher than silicone oil tends to push the gas bubble upward.[11] Another advantage is that postoperative prone positioning is not required and an upright posture may help maintain the two bubble in desired position.

One of the intraoperative challenges of this technique could be to assess the proportion of gas and oil intraoperatively. This challenge may be overcome by silicone oil injection under intraoperative illumination. Once intraocular gas starts getting absorbed, the inferior most tamponade may become insufficient. However, chorioretinal adhesion due to endolaser formed within 2 weeks. In our cases, breaks were located approximately 2–3 disc diameter posterior to ora serrata. Therefore, we achieved sufficient scarring of the laser marks before the silicone oil shows underfill. This is in accordance with the previously published literature which states that postlaser photocoagulation in previously detached retina, the maximal adhesive force increased to up to 300% of normal at 14 days.[12]

This technique appears promising for RD with inferior breaks as, unlike PFCL, gas does not need early additional surgery for removal. However, on the other hand, silicone oil still needs to be removed at a later date and in view of underfill has a higher tendency to emulsify.

We propose this novel sandwich technique using intraocular gas (C_3F_8) and silicone oil which has an advantage of providing both superior and inferior tamponade. A large-scale case study to determine the long-term efficacy of this technique in terms of anatomical and visual outcome is warranted.

Conclusion

We report a novel surgical sandwich technique using a combination of perfluoropropane and silicone oil, which

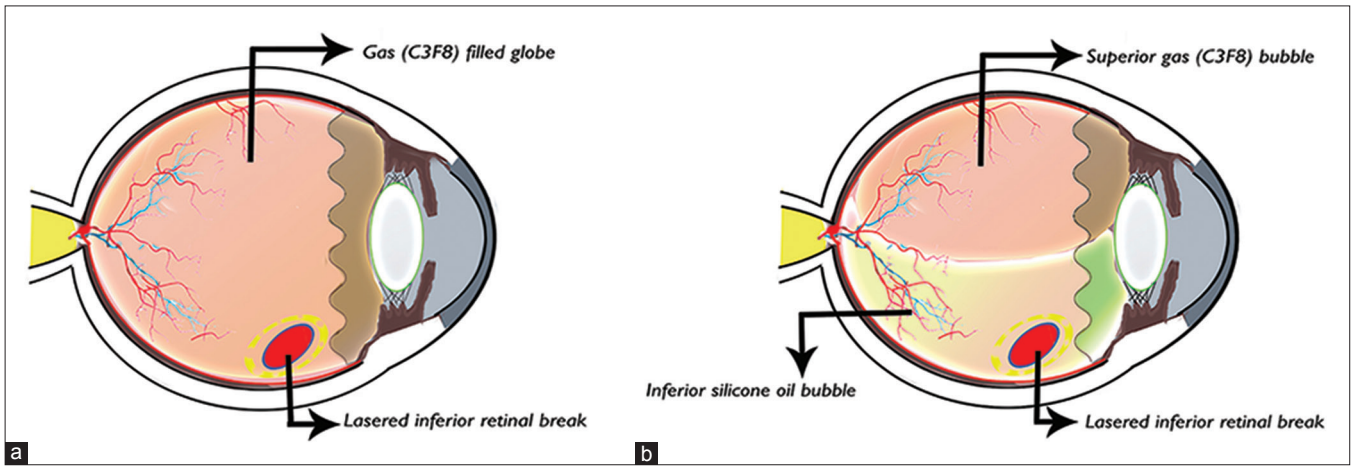

Figure 1: (a) The diagrammatic representation of eye completely filled with 14% perfluoropropane with attached retina. (b) Sandwich filling of silicone oil (1/2) and intraocular gas perfluoropropane (1/2)

Table 1: The preoperative and postoperative details of the patients who underwent sandwich technique (14% perfluoropropane) and silicone oil (1000 cs) injection

Age/gender	BCVA (preoperative)	Lens status	Location of break	BCVA (postoperative)	Fundus	Follow up
63/female	20/40	Pseudophakic	ITQ	20/125	Retina attached	1 month
69/female	20/80	Pseudophakic	ITQ	20/50	Retina attached†	2 months
51/male	CFCF	Phakic	Multiple inferior breaks	20/80	Retina attached	2 months
46/male	20/80	Aphakic§	ITQ	CFCF	Retina attached†	6 months

†Postsilicone oil removal, §Patient had a recurrent retinal detachment with inferior proliferative vitreoretinopathy. Subsequent to second surgery patient developed corneal decompensation. Silicone oil removal was done at 4 months and in view of pale disc, further corneal intervention was deferred. ITQ: Inferotemporal quadrant, CFCF: Counting fingers close to face, BCVA: Best-corrected visual acuity

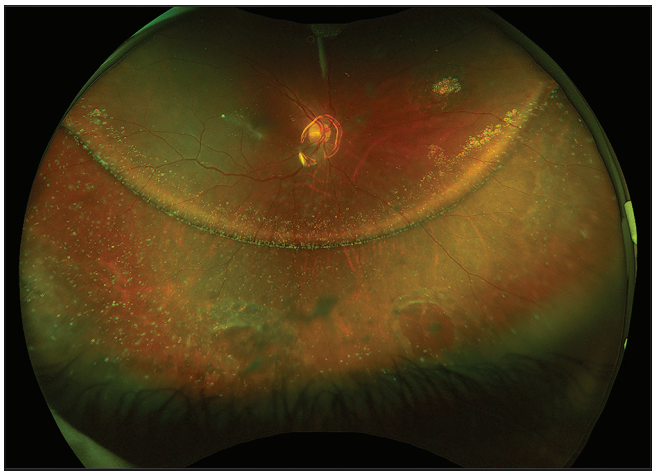

Figure 2: A wide-field fundus image of a patient who underwent sandwich technique for retinal detachment associated with inferior retinal break, showing attached retina, flat inferior breaks, and half-filled silicone oil. The patient was a 51-year-old male who had a history of diminution of vision in right eye for past 4 months. Fundus showed the presence of rhegmatogenous retinal detachment with multiple inferior breaks and early proliferative vitreoretinopathy changes. He underwent retinal detachment repair using sandwich technique. After the sandwich technique, the patient maintained upright position for 2 weeks. Best-corrected visual acuity at 2 months follow up improved to 20/80 with attached retina

provides adequate intraocular tamponade to both superior and inferior retina, respectively. This technique can be helpful in cases with inferior retinal detachments to reduce the recurrence rates.

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Conflicts of interest

There are no conflicts of interest.

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