

Aspiration of viscous plug in macular hole surgery- a case series

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Abstract: Macular hole surgery has been revolutionized since the 1990s' with the advent of pars plana vitrectomy with internal limiting membrane peeling and gas tamponade, which is now extensively practiced and regarded as the gold standard procedure for surgical treatment of macular hole. Here, we report a simple adjunctive maneuver to conventional PPV with ILM peel and gas tamponade. We observed presence of a viscous fluid in the base of the macular hole in our series. In all, 40 eyes of 39 patients consecutively operated on from June 2019 to December 2020 for PPV with ILM peel and gas tamponade, were included in this study. The viscous plug was aspirated passively using a 25 gauge cannula with its tip above the macular hole, approaching only until a fluid-wave was visualized, which resulted in flattening of the fluid cuff area aiding the macular hole closure in a concentric pattern. Macular hole closure and complete success was seen in 39 out of 40 eyes (97.5%) and only 1 failure (2.5%) observed in this series. In our case series, we have observed the presence of a viscous fluid plug in the macular hole. We demonstrated that aspirating this thick fluid from the hole results in the flattening of the cuff of fluid and subsequent closure of the macular hole in a concentric manner in almost all cases in our series. The lack of concurrent control group means we cannot state a definitive effect of the intervention, but it does suggest the utility of a prospective randomized controlled trial.

Keywords: ILM peel, macular hole, retinal surgery, vitrectomy

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Introduction

Macular hole surgery has been revolutionized since the 1990s' with the advent of pars plana vitrectomy (PPV) with internal limiting membrane (ILM) peeling and gas tamponade, which is now extensively practiced and regarded as the gold standard procedure for surgical treatment of macular hole.^{1,2} Conventional PPV with ILM peel achieves high rate of success, typically above 90%, but some patients experience persistent macular hole after primary surgery.³ In order to improve the success rate, there have been modifications to conventional macular hole surgery, such as the inverted and free ILM flaps, use of heavy silicon oil tamponade, autologous platelets, and amniotic membrane grafts.

Here, we report a simple adjunctive maneuver to conventional PPV with ILM peel and gas

tamponade. We observed presence of a viscous fluid in the base of the macular hole in our series. This 'viscous plug' is aspirated, and in doing so it is hypothesized that the more proteinaceous plug is replaced intraoperatively by surgical saline thereby reducing the splinting effect of the plug which may impede hole closure. The role of aspiration of viscous plug in this retrospective case series is the suggestion of further improvement in the success rate of macular hole surgery as compared to the conventional PPV with ILM peel.

Methods

In all, 40 eyes of 39 patients consecutively operated on from June 2019 to December 2020 for PPV with ILM peel and gas tamponade, were included in this study. 2 eyes had a combined procedure of phacoemulsification cataract

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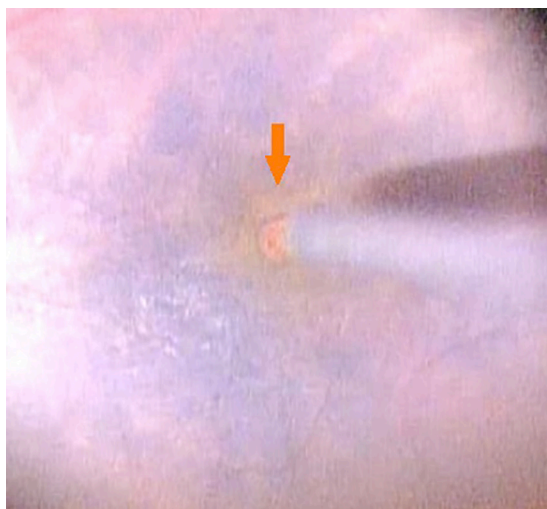


Figure 1. Orange arrow pointing at the fluid wave during macular hole fluid aspiration.

extraction at the time of macular hole surgery and only 1 eye was a re-do macular hole surgery. In all, 22 eyes were Stage-2 macular hole, pre-operatively according to the Gass classification,⁴ while 9 eyes were Stage-3 and another 9 eyes were Stage-4.

Surgical technique

A 25 gauge (G) trans-conjunctival pars plana vitrectomy was performed using the Bausch & Lomb Stellaris PC (Bausch and Lomb inc, California, USA) with a 25G system (Bausch + Lomb Global Surgical Headquarters, Aliso Viejo, Canada). Initially, a core vitrectomy was carried out in all the eyes for surgery irrespective of macular hole stage, then posterior vitreous detachment induced where required followed by peripheral vitrectomy with the aid of assisted scleral indentation. A blue dye (Membrane blue 0.15% -Dutch Ophthalmic, USA) was injected into the vitreous cavity directed toward the macula using a soft tip cannula, taking care to avoid a direct jet toward the hole. ILM peel was performed using intraocular end gripping forceps (Bausch and Lomb inc, California, USA). The viscous plug was aspirated passively using a 25 gauge cannula with its tip above the macular hole, approaching only until a fluid-wave was visualized (Figure 1), using caution, without touching the edges of the macular hole or the retinal pigment epithelial layer (RPE) around its edges and this resulted in flattening of the fluid cuff area aiding the macular hole closure in a concentric

pattern. After peripheral retinal inspection and fluid-air exchange, 20% concentration—sulfur-hexafluoride (SF6) gas was injected to replace the vitreous in 63% eyes while, 20% hexafluoroethane (C2 F6) was used in 22% eyes and 14% octafluoropropane (C3 F8) was used in 15% eyes. Use of different gases was based on the stage and chronicity of macular hole. The patients were prone postured for at least 48 hours postoperatively, instructed to target 50 minutes per hour looking downward. Topical dexamethasone 0.1% drops were used four times daily for 3 weeks.

Assessment

Patients were evaluated preoperatively and at least on postoperative day 1, week 2, week 6 and 6 months. Postoperative assessment included visual acuity, IOP measurement, slit lamp bi-microscopic examination and OCT imaging using Spectralis SD-OCT (Heidelberg Engineering). In all, 6 weeks follow-up was chosen as the main assessment in this series. This is our standard follow-up practice as the gas is fully absorbed by then and any residual IOP or uveitis is usually picked up at that visit, however, a 6-month follow-up was also included though around 20% of the patients could not attend that assessment due to the corona virus (COVID-19) pandemic and other reasons. Visual acuity was recorded using Snellen visual acuity chart for documentation and data analysis.

Data and consent

Data were studied and analyzed retrospectively using Microsoft Excel 2019 version software. The tenets of the World Medical Association Declaration of Helsinki were followed along with the approval from local audit department. We also obtained informed consent from all subjects.

Results

In all, 40 eyes were included in this series with mean age of the patients being 71 years. Fifteen patients (37.5%) were male and 25 patients (62.5%) were female. A total of 37 eyes (92.5%) were phakic and 3 eyes (7.5%) were pseudophakic (Table 1).

Average size of macular hole was 408 μ m (SD 150.9). In all, 23 eyes had SF6-20% gas as the tamponading agent, 1 eye had SF6-18%, 5 eyes

Table 1. Results summary.

Total no. of procedures	Average patient age	Macular hole stage (Gass classification)	Macular hole diameter (Microns)	Mean pre-op V/A (Snellenchart)	Mean post-op V/A (Snellen chart)	Lens status-Phakic	Lens status-Pseudophakic	Surgical success rate (%)
40	70.9	Stage-2: 22 Stage-3: 9 Stage-4: 9	408.5	6/36	6/24	37	3	97.5

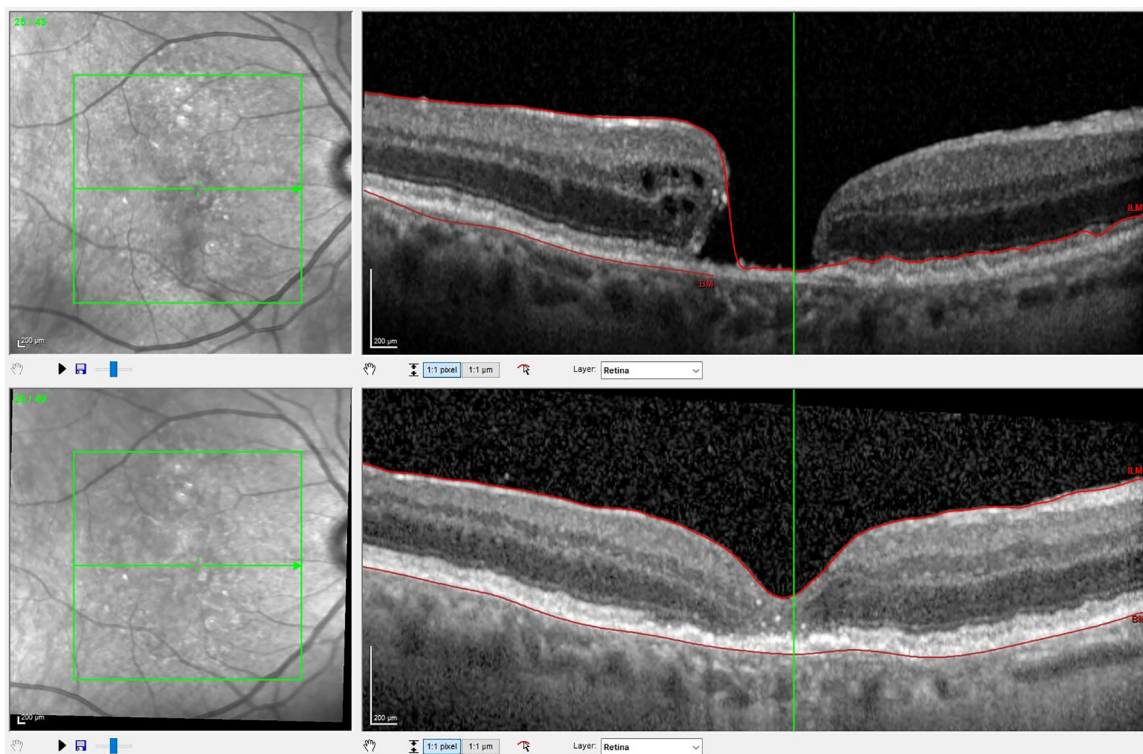


Figure 2. Figure showing a merged OCT scan of the Rt eye of one of the operated patients in this series. The top image showing pre-op Stage-4 macular hole and bottom image shows a complete closure of the hole postop.

had C3 F8- 14%, 1 eye had C3 F8-12%, while 6 eyes had C2 F6- 20% and 3 eyes had C2 F6- 18% gas. Mean preoperative VA was 6/36 and mean postoperative VA was 6/24 on Snellen chart at week 6. This remained much the same with 6/12 mean VA on Snellen chart at 6 months; however, around 20% of the patients did not attend their follow-up visit at 6 months review, and therefore, their VA could not be included at this visit. There was an overall improvement of 2 lines in the vision on Snellen chart measurement at 6 weeks and 6 months post operatively. Macular hole closure and complete success was seen in 39 out of 40

eyes (97.5%) and only 1 failure (2.5%) observed in this series which was a stage 4 macular hole.

Figure 2 shows the complete closure of right eye stage 4 macular hole in the comparative macular OCT image of one of the operated eyes from this case series.

Brief OCT analysis of operated eyes was also performed post operatively which was focused mainly on the foveal area, inner segment/ outer segment (IS/OS) junction and external limiting membrane (ELM).

All the 40 eyes showed presence of foveal dip post operatively on OCT. Foveal dip had some anatomical irregularity in 29 eyes; however, there was no apparent irregularities of foveal dip in 11 eyes.

In all, 32.5% eyes had an intact IS/OS junction on OCT while, 67.5% eyes in this series showed an IS/OS defect post operatively in the early period. Intact ELM was observed in 57.5% eyes post op while, 42.5% eyes had a disruption in ELM on OCT. All eyes with disruption in ELM had a defect in IS/OS junction too. All eyes with intact IS/OS junction also had an intact ELM line. None of these defect areas were measured quantitatively in this series. Furthermore, only 1 eye showed residual intra retinal cysts post operatively.

Discussion

The primary treatment strategies for macular hole surgery have been standardized with ILM peel and gas tamponade. Meta-analyses of macular hole surgery have shown that ILM peeling have markedly improved the post operative vision as well postoperative hole closure rate.^{5,6} However, in spite of high success rate, surgical failure is still encountered.

For refractory macular holes, a number of surgical strategies have been reported as adjunctive procedures for refractory hole closure; such as heavy silicone oil use as tamponading agent,⁷ pedicle ILM flap technique,⁸ enlarging previous ILM peel,⁹ lens capsular flap transplantation,¹⁰ and autologous free ILM flap.^{11,12} In our case series, we have observed the presence of a viscous fluid plug in the macular hole. We demonstrated that aspirating this thick fluid from the hole results in the flattening of the cuff of fluid and subsequent closure of the macular hole in a concentric manner in almost all cases in our series. The flattening of the cuff area was observed during surgery as a wave around the edges of the whole. Furthermore, we observed no adverse effects and no damage to the macular hole edges or to the RPE as a result of this fluid aspiration technique.

In our series, 67.5% eyes showed an IS/OS defect while 42.5% eyes showed a disrupted ELM line post operatively on OCT analysis. Also around 72% eyes had some foveal dip irregularity. All these are common findings after conventional macular hole surgery and are consistent with

studies reporting similar rates in conventional macular hole surgery without macular hole plug aspiration.^{13,14}

Prior to this series, a similar technique had been reported by Shimada *et al.*,¹⁵ where they showed successful closure of macular hole in all eyes in their case series. In their technique, they used active aspiration however, which we believe could pose a greater risk to the RPE at the base of the hole.

Endoscopic drainage technique of macular hole fluid has also been described under perfluorocarbon liquid (PFCL) by several researchers previously.^{16–18} In our series, no PFCL was required, and the maneuver was simple and expedient during removal of dye prior to ILM peel. There was no special instrumentation or entries in to the eye other than already utilized in standard surgery.

We believe that aspiration of this macular hole fluid plug results in flattening of the cuff area and reduces the resistance to closure with a gas or air tamponade overlying the hole. The lack of concurrent control group means we cannot state a definitive effect of the intervention, but it does suggest the utility of a prospective randomized controlled trial. In summary, further studies including the use of intraoperative OCT, detailed measures of foveal function, and randomized control trials are required to establish the true safety and efficacy of this technique.

Conflict of interest statement

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Ethics statement

This study was a retrospective case series and therefore did not require an ethical board approval.

Written informed written consent was obtained from all the patients for this case series information and for the images related to the case report to be published anonymously for educational and research purposes.

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