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CASE REPORT

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Foldable Capsular Vitreous Body Implant For Post-Traumatic Phthisical Eye

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Abstract

Purpose: To analyze the outcomes of foldable capsular vitreous body injected in a post-traumatic phthysical eye.

Case presentation: A 19 year-old male patient presented to the ophthalmology department with left post-traumatic phthisical eye , who had previously undergone corneoscleral tear repair due to a penetrating trauma to his left eye one year ago. On ocular examination , there is a corneo scleral scar mark, aniridia , aphakia and retina incarcerated in the scar. He was injected with a foldable capsular vitreous body.

Conclusion: Our case report of foldable capsular vitreous body gives an excellent cosmesis for the phthisical eye.

Introduction

Vitreous is a transparent, gelatinoid structure occupying major bulk of eye. Vitreous cortex is a thin membrane like structure and extends from the ora serrata to the posterior pole. The function of vitreous body is to support the posterior segment also provide an excellent refractive medium, transports oxygen and inhibits cells migration from retina to the vitreous cavity.(1)The disfigurement associated with the loss of an eye may cause significant physical and emotional problems. Loss of an eye may occur due to malignancies, congenital defects, irreparable traumas, the presence of a painful blind eye, and sympathetic ophthalmia. Depending on the severity of the involvement, the surgical operation in these patients may involve evisceration, enucleation, and exenteration (2). Here we present a case of foldable capsular vitreous body which is injected in the posterior segment of a post traumatic phthisical eye to give an excellent results in terms of cosmesis and maintenance of eye ball.

Case presentation

A 19 year old male, unmarried, student by occupation presented in out-patient department of ophthalmology with the complaints of sunken and shriveled left eye ball. His complaints started after he had undergone corneo-scleral tear repair for a trauma. One year ago he received a blunt trauma to his left eye resulting in corneo-scleral rupture and uveal prolapse, he went to the emergency department and got his primary repair done, due to the severity of trauma his vision was no light perception (NLP) and later on started shrinking. This unsightly look of a shriveled eye made him consult for any further cosmetic treatment. On slit examination of his left eye there was a leucomatous corneal scar mark in a paracentral area going beyond the limbus, irregular anterior chamber depth, aniridia and aphakia, fundus details were hazy for which B- scan was performed and is shown (Figure 1). Some part of retina was found in-

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carcerated in the corneal scar. Examination of the right eye revealed 6/6 vision and both anterior, posterior segments within normal confines.

We planned to inject a foldable capsular vitreous body (FCVB) in this case, as a volume replacement and to protect the eye ball form further shrinking. Procedure was done under general anesthesia and for which patients suitability for anesthesia was examined pre-operatively. Under the microscope; peritomy was done and full thickness entry of 3.5mm was created in the sclera 5 mm behind the limbus in the supero-temporal quadrant, with the help of an injector vitreous body was injected in the posterior segment (Figure 2A-F). Foldable capsular vitreous body is a foldable round body made up of biocompatible polymer, contains vitreous like sheet and is attached with a drain tube valve system. Body goes in the eye ball whereas the tube with valve stays out and once the body is in the posterior segment, adequate amount (checking digital IOP while injecting silicon oil) of silicon oil is injected in the FCVB which serves two purposes, maintains the volume and shape of the eye ball and also avoids silicon oil emulsification and displacement. After the surgery adequate volume replacement was observed and post-operative pictures are also shown. Since this is a cosmetic procedure, visual prognosis was already explained to the patients and remained the same at the 3rd month (Figure 3), IOP monitoring with applanation tonometry was done on subsequent follow-ups and it remained within normal limits.

Discussion

Our study demonstrated that the FCVB injected with silicon oil as a vitreous substitute had good biocompatibility and retina support function in the vitreous cavity after a long-term tamponade. This revealed that the new approach of using FCVB combined with silicon oil may yield an ideal artificial vitreous substitute for long-term vitreous replacement. This new approach greatly improved stability of ocular structure and together with the silicon oil acting as an excellent vitreous substitute.

Foldable capsular vitreous body is made from a biocompatible polymer and contains a vitreous like capsule and tube drain system. Its major roles are to support retina and maintain the shape of eyeball and avoid silicon oil emulsification and displacement. They have the best comfort level for the patient and depends upon the axial length and antero-posterior diameter. Recommended silicon oil volume for different axial lengths are shown in the table 1 as recommended by the manufacturers.

An ideal vitreous substitute should mimic the native human vitreous in both form and function. It should have similar viscoelastic properties to the native vitreous in order to maintain a physiologic-range intraocular pressure and support the retina in a proper position (3). The substitute should also be clear and transparent. It should be stable, permanent, and biocompatible, without any toxic reactions during long-term use (4). Meanwhile, the ideal substitute would be easily manipulable during surgery and injectable through a small syringe (5).

Currently, only silicone oil is accepted as a long-term vitreous replacement. However, silicone oil has many disadvantages as a vitreous substitute, such as secondary glaucoma, cataract formation, hyperopic shift, oil emulsification, keratopathy, and in cases of non-effective tamponade, the inferior retina breaks (6-11). Short-term persistence of a vitreous substitute in a vitreous cavity will not be sufficient efficacy in the treatment of complicated retinal detachments or retinal detachments with proliferative vitreoretinopathy. Therefore, researchers have been trying to find an ideal alternative material that may be left safely in the vitreous cavity as a long-term tamponade. The hydrogels (e.g., PVA, PAA) can closely mimic the light transmittance of the natural vitreous humour, as well as its physical and mechanical properties, and may therefore be the best candidates for vitreous substitution (12,13). However, to our knowledge, they have the primary drawbacks of a short residence time and biodegradation in vivo.

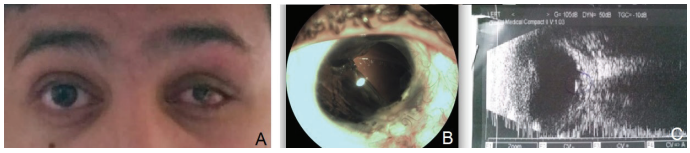

Figure 1Preoperative photos and B-scan ultrasound image of patient

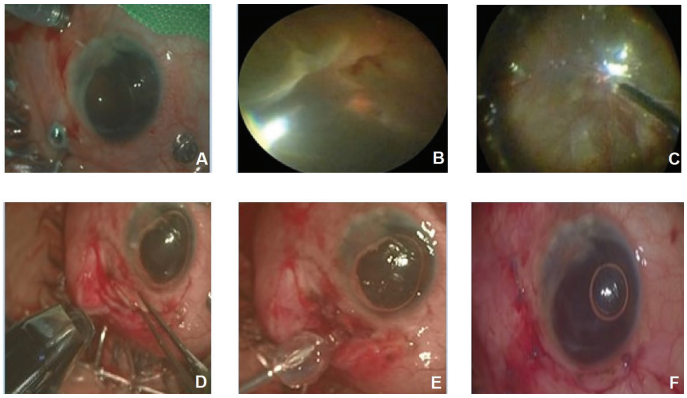

Figure 2 (A-F) Peroperative photos of Foldable Capsular Vitreous Body implantation

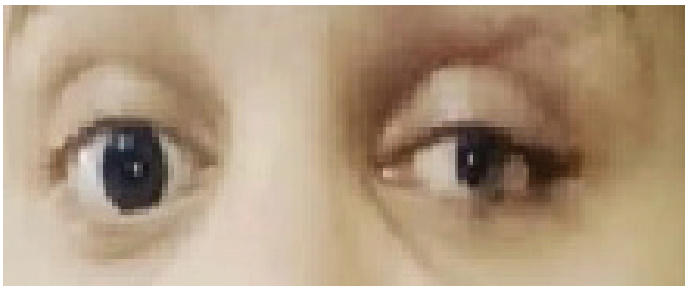

Figure 3 Photo of the patient at postoperative 3rd month

The PVA hydrogel is deemed to be one of the most promising candidates for vitreous substitution due to its optical properties, rheological features, and long-term biocompatibility (13). In previous studies (14-16), the PVA hydrogel has been confirmed to have excellent optical properties and safety in vitro or in vivo, but further studies need to be performed in order to show their retention time, mechanical properties, and ability to reattach the retina within the eye.

In this case, we are reporting that for a pthisical post-traumatic eye foldable capsular vitreous body(FCVB) is an excellent cosmetic hope. It gives a good volume shape to the eye ball and complications associated with silicon oil are minimized to much extent ,providing a better shape and maintain a volume for longer term is a new hope for psychologically suppressed patients with phthisis. One study demonstrated that the FCVB had cellular barrier function and could avoid silicone oil emulsification and migration. Therefore, the FCVB could serve as an isolator in order to avoid PVA hydrogel biodegradation or absorption and displayed better all-round retina support.

We followed the patient for 3 months and is associated with very few complications and gives good shape to the eye ball . The results were similar to many of previous research project.(19,20)

For application during vitrectomy, the hydrogel should be injectable through a needle. During injection, the molecular chains of the polymer will be subjected to an external shear stress, which may result in the massive mechanical breakage of the crosslinks, inducing a significant loss of elasticity (G′ decreases), causing the hydrogel to become more fluid-like and viscous. Our rheologic experiments showed that after their injection through a 19-gauge needle, the storage modulus G′ and the loss modulus G″ of the 3% PVA hydrogel were approximately equivalent to those before injection. This indicated that the injection did not affect the network structure of the 3% PVA hydrogel and that it had similar rheological behavior before and after injection.

Table 1 Recommended silicon oil volume for different axial lengths by the manufacturers.

Sr. no.	Axial length	Silicon oil volume
1	16-19.9	0.7-0.9
2	20-21.4	1.4-1.7
3	21.5-22.9	1.8-2.2
4	23-24.9	3.5-4.0
5	25-28	4.0-5.0

Previous studies showed that the fragmentation of a PVA hydrogel in the vitreous cavity and the resulting muddiness of the vitreous cavity occurred after the implantation of the PVA hydrogel.(20)

In one of the previous study (17), it is established that most of FCVB-implanted eyes developed cataracts after a long-term tamponade. In order to better observe fundus, we had to perform lensectomy which lead to secondary lesion. Therefore, in this study, lensectomy was performed during vitrectomy in the PVA + FCVB -treated eyes.

In another study no significant changes in IOP were observed after 7, 14, 30, 60, and 90 days, but there was an increasing IOP at 3 days after PVA hydrogel and BSS implantation, which may have resulted from anterior chamber inflammation after the operation. In contrast, the IOP in the PVA + FCVB group decreased at 3 days after operation. This may have been due to a leakage of the aqueous humor at the incision for the FCVB implantation. Meanwhile, a significant decrease in IOP was observed at 180 days after PVA hydrogel direct implantation, which may have occurred because of hydrogel degradation and absorption.(22)

In the PVA + FCVB-implanted eyes, a histopathologic examination showed that the structure of retina was intact without obvious pathological changes on postoperative 90 days. However, retinal disorder and proliferation were observed at 180 days after implantation, which may have been caused by a long-term FCVB capsule-induced mechanical pressure to the retina.(23)

In conclusion, the FCVB tamponade with silicon oil seems to have good stability and transparency in the vitreous cavity. The FCVB can safely prolong its retention time and effectively improve its stability performance in the vitreous cavity. Also this novel approach may indicate that the FCVB is suitable for other hydrogels (e.g. PVP, PAA) tamponade. Moreover, many nanometer-wide

apertures exist in the FCVB, and drugs can be released from the FCVB (21-24) , so a drug may be added to the hydrogels, providing clinicians with a slow-release drug device. Therefore, this novel approach may develop into a new ideal vitreous substitute and open new options for the prevention and treatment of vitreous retinal diseases.

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