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Case Study

Surgical Management of Posterior and Retracted Retinal Breaks with Amniotic Membrane Plugs: A Case Series

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Abstract

Purpose: To evaluate mid-term safety and efficiency of a new surgical technique using amniotic membrane plugs for the treatment of posterior pole and/or retracted retinal breaks in tractional and delayed rhegmatogenous retinal detachment.

Methods: Patients with rhegmatogenous associated to at least grade C proliferative vitreoretinopathy or tractional retinal detachment with retinal breaks sealed by amniotic membrane plugs were included. Minimal follow-up of 12 months with visual acuity evaluation, optical coherence tomography, retinophotography, intraocular pressure and re-detachment rate evaluation at 1, 3, 6 and 12 months.

Results: 9 eyes of 9 patients were included. The mean 12-month post-operative best corrected visual acuity was 1.12 logMar. Fundus photography and optical coherence tomography shows that the plugs stayed in place at 1,3,6 and 12 months without dislocation. Glial tissue regeneration was noticed without original retinal layers restoration. Only one retinal re-detachment occurred after silicone oil removal. Neither elevation of intraocular pressure nor signs of inflammation were registered.

Conclusion: Amniotic membrane plugs represent safe and efficient surgical technique to manage posterior pole and/or retracted retinal breaks without the limitations of laser retinopexy.

Keywords: *Amniotic Membrane; Rhegmatogenous Retinal Detachment; Tractional Retinal Detachment; Vitreoretinal Proliferation; Vitreoretinal Surgery*

Introduction

Retinal detachment is a sight threatening condition due to the separation of the neurosensory (inner layers) retina from the retinal pigment epithelial (RPE) layer by the accumulation of subretinal fluid. Its incidence is approximately 1 in 10000 [1].

Retinal detachment can occur in three ways: rhegmatogenous, tractional and exsudative. The more common mechanism is the occurrence of a retinal break associated with the posterior vitreous detachment or trauma, allowing vitreous to enter to the subretinal space (rhegmatogenous retinal detachment).

It can result in some cases in chronic delayed diagnosis rhegmatogenous retinal detachment with the contraction of epi or subretinal membranes: this is called proliferative vitreoretinopathy [2].

Tractional retinal detachment can occur in proliferative retinopathy due to diabetic disease or other diseases leading to neovascularization of the retina such as central retinal vein occlusion.

The surgical management of chronic delayed diagnosis rhegmatogenous and tractional retinal detachment often turns out to be complex. It implies vitreous removal and membrane dissection to release the tractions, and retinal breaks treatment. The induction of posterior vitreous detachment or membrane dissection may result in iatrogenic retinal break. If the iatrogenic retinal break occurs in the periphery, it may be treated with laser retinopexy. However, if the retinal break is posterior, the laser retinopexy could result in central or paracentral visual field loss: it should be a last-resort option. Moreover, if the retinal break is not completely flattened, the laser retinopexy is not effective. In patients with pale high myopic pigmentary epithelium or pigmentary epithelium atrophy, laser retinopexy is less effective with a higher risk of retinal detachment recurrence. Recently, human amniotic membrane plugs have been reported to treat recurrent macular hole and high myopia-associated retinal detachment, with good functional and anatomical outcomes [3].

In our study, we tried to address these posterior and/or retracted retinal breaks with membrane amniotic plugs. We described a new surgical technique and evaluated the structural recovery of the retina and the anatomical outcome of these plugs. The mid-term safety and tolerance were also analyzed.

Methods

This was a retrospective, consecutive case series study conducted at the University Hospital Center of Rouen. Patients with retinal detachment receiving amniotic membrane plugs from February 2019 to December 2022. This study was performed according to the postulates of the Helsinki declaration, and the patients accepted to participate in this surgical procedure performed in the context of an investigation.

Patients with rhegmatogenous retinal detachment associated to at least grade C proliferative vitreoretinopathy or tractional retinal detachment associated to posterior retinal breaks (which is located within the vascular arcades) and/or original or iatrogenic tracted retinal breaks, receiving human amniotic membrane were included. Patients with macular hole-associated retinal detachment, with concomitant inflammatory condition, and with follow-up less than 12 months were excluded.

All included patients underwent thorough ophthalmological examinations including slit-lamp and indirect ophthalmoscopy examinations, color fundus photography, and spectral-domain optical coherence tomography (OCT) (Zeiss Cirrus 5000 HD, USA) at 1 week, 1, 3, 6 and 12 months after surgery. Data including age, gender, and best-corrected visual acuity (BCVA) were recorded. All the patients were followed up at the hospital for at least 12 months after the surgery. Outcome measures included BCVA, BCVA improvement, type of tamponade, anatomical outcome of the plugs (OCT), structural recovery of the retina and the re-detachment rate at the end of follow-up (ophthalmological examination and wide-field color fundus photography).

Surgical technique

All cases underwent standard three-port 23-gauge pars plana vitrectomy (DORC Laboratories, Deutschland). After core vitrectomy, triamcinolone and Brilliant blue dying, the fibrovascular and proliferative vitreoretinopathy membranes over the retina were removed by using either cutter or forceps or scissors with a bimanual technique. This surgical management is challenging and iatrogenic retinal breaks may occur. Flattened and peripheral retinal breaks were managed with laser retinopexy. However, if the break was very posterior, or if it couldn't be properly flattened, an amniotic membrane plug was used. Perfluorocarbon liquid was used for all the cases in order to flatten as much as possible and correctly position the plugs. To implant the plugs over the retinal breaks, the soft tip was first used to drain the subretinal fluid through the breaks to flatten the retina as far as possible, then a 23-gauge forceps was used to grasp and position the plug.

For amniotic membrane plugs: the human cryopreserved amniotic membrane from our hospital's tissue bank was defrosted before the implantation. It was cut under the microscope in order to create small pieces and inserted into all the identified retinal breaks through the trocar.

After securing the graft, air-fluid exchange was performed, accompanied by silicone oil tamponade. No laser retinopexy around the breaks were performed. Suture of the sclerotomies was used. All patients were asked to maintain a position according to the location of the retinal breaks. Silicone oil was removed several months after surgery according to the severity of the retinal detachment, and patients with cataract formation underwent lens extraction and intraocular lens implantation. All surgeries were performed by a single experienced vitreoretinal surgeon.

Statistical analysis

Snellen BCVA was converted to the logarithm of minimal angle of resolution (logMar) and expressed as mean values and standard deviation.

Results

A total of 9 eyes of 9 patients were included. The mean age was 68.3 years old. 5 patients suffered from a severe and chronic rhegmatogenous retinal detachment with proliferative vitreoretinopathy and 4 had a tractional retinal detachment with fibrovascular proliferation. Overall, 5 breaks were located in the posterior pole and 4 in the mid-periphery. Laser retinopexy was the rule when possible and safe. All the cases were first surgeries.

Postoperatively, the retina was successfully reattached in all the eyes. All the patients received silicone oil tamponade. Silicone oil was removed without recurrence after an average of 8 months for 8/9 eyes. The mean preoperative best corrected visual acuity was 2.16 logMar and the mean 12-month post-operative best corrected visual acuity was 1.12 logMar. The mean visual acuity improvement was 1.04 logMar (Table 1).

Male/Female	4/5
Age (years), (min-max)	68.3 (53-78)
Indication n (%)	
Proliferative vitreoretinopathy	5 (55.6%)
Fibrovascular proliferation	4 (44.4%)
Tamponade n (%)	
Silicone oil	9 (100%)
Preoperative BCVA (logMar)	2.16 +/- 0.80
Postoperative BVCA (logMar)	1.12 +/- 0.75
VA improvement (logMar)	1.04 +/- 0.68
Number of retina re-detachment n (%)	1 (11.1%)

Table 1

Fundus examinations, fundus photography, and optical coherence tomography confirmed that the retinal breaks had been sealed by the plugs. Serial OCT revealed that all the plugs stayed in place without dislocation. The graft size also seemed to be stationary without lysis. No postoperative major adverse event was found.

Figure 1 and 2 show two cases of severe rhegmatogenous retinal detachment with a large temporal posterior break treated with amniotic membrane plug. Fundus photography showed the stability of the plug over the follow-up and OCT showed the plug properly sealing the retinal break without subretinal fluid at 1 and 6 months in both cases. In one case, a small uncovered area next to the plug occurred at 3 month (Figure 2), but we could notice glial tissue regeneration over this area at 6 months without retinal detachment recurrence.

Figure 1: *Postoperative color fundus photography and serial optical coherence tomography (OCT) exams of a retinal break treated with amniotic membrane plug.*

A, B: Color fundus photography at 3 and 12 months postoperatively showing that the retinal breaks are securely sealed by the plug (arrows).

C, D: OCT scans over the location of the break at 1 and 3 months showing the retinal breaks sealed by the plug.

E, F: OCT scans over the same location at 6 and 12 months showing the plug in place without dislocation, or lysis. No retinal or glial tissue regeneration was observed.

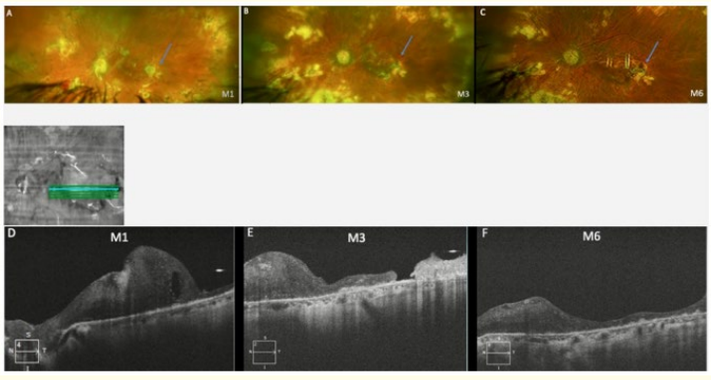

Figure 2: *Pre and Postoperative ultra-widefield pseudocolor fundus photography and serial optical coherence tomography (OCT) exams of a retinal break treated with amniotic membrane plug.*

A, B, C: Ultra-widefield pseudocolor fundus photography at 1, 3 and 6 months showing that the retinal breaks are securely sealed by the plug.

E: OCT scan over the location of the retinal break at 1 month showing the correct position of the plug over the break.

F, G: At 3 months, OCT scan over the location of the retinal break showing a small uncovered area, with glial tissue regeneration at 6

Only one case of retinal re-detachment occurred 6 months after initial surgery with silicone oil tamponade. It turned out to be a recurrence of large fibrovascular membrane next to the amniotic membrane patch in a patient with a long-lasting unbalanced diabetes which was responsible for the re-opening of the break leading to the retinal re-detachment (Figure 3).

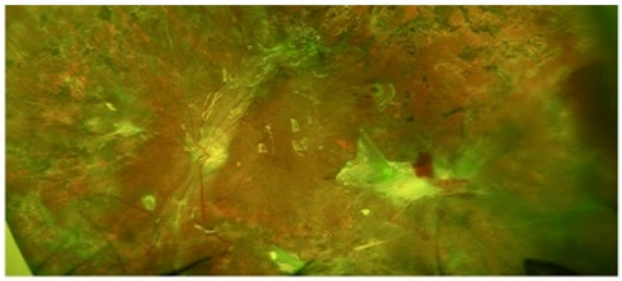

Figure 3: *Inferior temporal tractional retinal detachment following the treatment of a large retinal break with amniotic membrane plug.*

Ultra-widefield pseudocolor fundus photography showing the occurrence of an inferior temporal tractional retinal detachment 6 months following the treatment of a large retinal break with amniotic membrane plug.

Neither elevation of intraocular pressure nor signs of inflammation were registered during follow-up in our case report.

Discussion

The aim of rhegmatogenous retinal detachment treatment is the retinal break closure. Buckling is only useful to reattach the retina and retinopexy is a complementary treatment in case of buckling dislocation for instance, whereas cryopexia or laser create scars around retinal breaks.

Posterior retinal breaks treatment is controversial: many authors sustain that no laser is needed for retinal breaks within vascular arcades, but in some cases, they can result in vitreoretinal proliferation leading to retinal re-detachment. Moreover, in case of retracted retinal breaks, pigmentary epithelium atrophy, high myopic or pale pigmentary epithelium eyes, laser retinopexy is less effective.

In our study, we tried to fill these breaks instead of using retinopexy. The main surgical challenges we encountered were rhegmatogenous retinal detachment with advanced vitreoretinal proliferation and tractional retinal detachment. Indeed, in these cases, iatrogenic retinal breaks are often encountered during surgery, and some of them may be large, retracted and posterior. The subretinal fluid is generally chronic and therefore viscous, the retina is often rigid, which make it difficult to flatten with either perfluorocarbon liquid or air-fluid exchange intraoperatively [4]. All these features lead to the difficulty to apply the laser retinopexy around the breaks with high energy required. This heavy laser may increase postoperative inflammation and cause fibrous tissue proliferation around the breaks, increasing the risk of recurrence of the retinal detachment. The retinal break may not be securely sealed by the laser retinopexy and reopening of the breaks may happen the days or weeks following the surgery.

Furthermore, for some breaks occurring very posteriorly within the vascular arcade, laser photocoagulation at posterior pole would lead to permanent visual field defects and irrevocable visual impairment, with the risk of progressive enlargement of laser scars [5].

Recently, some studies suggested to use the free flap technique with free ILM or lens capsular plugs to treat posterior breaks without laser retinopexy with successful surgical outcome [6,7]. Free organic plugs could seal the retinal breaks and thus decrease the chance of

proliferative vitreoretinopathy development due to intravitreal migration of retinal pigment epithelial cells from exposed retinal pigment epithelium [8]. However, ILM or lens capsular plugs are not always available, especially for patients who underwent previous cataract surgery or ILM peeling surgery and are inappropriate for large retinal breaks.

Human amniotic membrane plays major role in the treatment of refractory large macular holes. However, few studies suggested to use human amniotic membrane patch to manage paravascular retinal breaks in tractional and rhegmatogenous retinal detachment with successful outcome [9]. Human amniotic membrane patch offers rich tissue resources conversely to ILM or lens capsular flaps. In our study, a complete retinal reattachment with visual acuity improvement was observed in the following 12 months for 8 out of 9 cases with amniotic membrane plug. Compared with standard surgery using only laser retinopexy, amniotic membrane patches would achieve higher retinal reattachment rate, decrease the need for additional surgery, and offer a higher visual improvement in these challenging cases. Compared with ILM or lens capsular flaps, amniotic membrane grafts had several advantages: their size could be tailored for retinal breaks, there is no concern about the sufficiency of the graft tissue especially for patients with multiple breaks, their anti-inflammatory and antifibrotic properties could prevent an epiretinal membrane development [10].

However, this study is subject to several limitations. The first is the small size of the sample and the retrospective design: this should be addressed in a future prospective study with a larger sample size. The second limitation concerns the inclusion of eyes with two different conditions: rhegmatogenous and tractional retinal detachment with a different pathophysiology and mechanism.

Conclusion

According to what has been observed in this case series study, amniotic membrane plugs may be a safe and efficient surgical technique to manage posterior pole or retracted retinal breaks in challenging rhegmatogenous and tractional retinal detachment. They offer an alternative solution to the laser retinopexy without limitations such permanent visual field defects or insufficient treatment in case of retracted retinal breaks.

Summary Statement

In this case series of 9 eyes, we describe the mid-term safety and efficiency of a new surgical technique using amniotic membrane plugs for the treatment of posterior and/or retracted retinal breaks in patients with rhegmatogenous associated to at least grade C proliferative vitreoretinopathy or tractional retinal detachment.

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