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The art of fixing a ticking time bomb: Combined phacoemulsification and amniotic membrane transplantation

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Abstract:

Bleb leakage is a notorious complication of glaucoma filtration surgery which increases the risk of sight-threatening conditions. A 25-year-old female with severe bilateral juvenile open-angle glaucoma was treated for blebitis and exogenous endophthalmitis secondary to chronic bleb leak after undergoing XEN implantation, followed by multiple rounds of bleb needling, and augmented trabeculectomy. In the right eye, visual acuity was hand movement with cataract, intraocular pressure was 6 mmHg and the bleb was large, highly elevated from 10 to 1 o'clock, avascular, thin wall, and cystic with leaking points. Combined surgery of low-setting phacoemulsification and amniotic membrane transplantation without excising and manipulating the bleb was performed in the same setting. At postoperative 1 month, 6 months, and 1 year, her right vision had improved to 6/24, and the intraocular pressure was 12–14 mmHg, and the bleb leakage had resolved. This successful treatment was accomplished by maintaining the bleb's viability, preventing additional injury, and promoting wound healing.

Keywords:

Amniotic membrane, bleb leakage, cataract, combined surgery, glaucoma

Introduction

Bleb leakage is a common complication of glaucoma filtration surgery that can lead to hypotony, blebitis, and endophthalmitis.^[1] Bleb revision, which typically involves bleb excision and conjunctival advancement, may be required when nonsurgical interventions fail. Amniotic membrane grafts can also be used for treatment.^[2-4]

However, to our knowledge, no one has reported on a combined surgery approach that addresses both bleb leaks and cataracts while minimizing manipulation of the bleb and surrounding tissue. We describe a case in which we performed a combined surgery procedure consisting of cataract surgery, intraocular lens implantation, and amniotic

membrane transplantation without bleb excision for a patient with chronic bleb leak and significant cataract.

Case Report

A 25-year-old female with bilateral severe juvenile open-angle glaucoma underwent bilateral XEN implantation after unsuccessful attempts to lower intraocular pressure through brinzolamide, brimonidine, bimatoprost, and timolol. However, XEN implants failed, and multiple rounds of needling with 5-fluorouracil were done bilaterally. She eventually underwent right eye augmented trabeculectomy with mitomycin 0.04%. Right eye chronic bleb leak occurred 12 months postoperatively and was complicated with blebitis and exogenous endophthalmitis. After blebitis and endophthalmitis were treated, a

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combined surgery for bleb leak and visually significant cataract was planned and performed.

On presentation, the patient had hand movement as the right visual acuity and a right intraocular pressure of 6 mmHg. The bleb in the right eye was large, highly elevated from 10 to 1 o'clock, avascular, thin walled, cystic, and had leaking points [Figure 1a and b]. The right anterior chamber was deep. The optic disc was mild pallor with a cup:disc ratio of 0.9. She also had a visually significant cataract in her right eye.

After unsuccessful nonsurgical interventions for 12 weeks using topical plain gentamicin 0.3% QID, oral doxycycline 100mg OD, and aqueous suppression, including oral acetazolamide 250mg QID and topical timolol BD, a combined surgery that involves phacoemulsification with a low setting, intraocular lens implantation, and amniotic membrane transplantation was performed. Phacoemulsification was performed first with lower fluidics, including lower infusion pressure, aspiration flow rate, vacuum settings, and phaco power which were chosen to lower the risk of damaging the leaking bleb. The phacoemulsification procedure for this patient was carried out using the Alcon Centurion system. The settings utilized during the surgery included an infusion pressure of 30 mmHg, an aspiration flow rate of 25cc/min, a vacuum level of 250 mmHg, and a torsional phaco power of 20%–30%.

After that, without excising the bleb and manipulating the surrounding tissue, a double-layer amniotic membrane, which consists of a deeper layer with the epithelial side up and the superficial with the epithelial side down, was applied over the leaking bleb with interrupted nylon 10-0 sutures [Figure 2].

At postoperative 1 month, 6 months, and 1 year, her right best-corrected vision had improved to 6/24, the intraocular pressure ranging from 12 to 14 mmHg, and the bleb leakage had resolved [Figure 3a and b].

Discussion

Bleb leakage is one of the notorious complications of glaucoma filtration surgery which can occur at any point of time after the surgery. It results from the disintegration of conjunctiva overlying a sclerotomy. A meta-analysis showed the usage of antimetabolite, including 5-fluorouracil or mitomycin C during bleb needling, further increases the risk of bleb leak to 5%.^[5] The disintegration of the surface epithelium leads to the drainage of aqueous humor through the conjunctiva, which raises the chances of blebitis, endophthalmitis, hypotony maculopathy, choroidal detachment, corneal folds or edema, fluctuation of refractive errors, or tearing

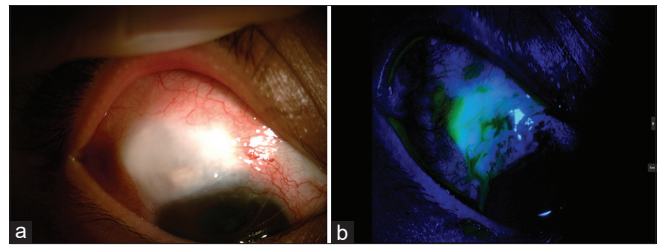


Figure 1: Photo of the right eye with a large avascular leaking bleb under diffuse illumination (a) and cobalt blue light with fluorescein stain (b)



Figure 2: Photo of the right eye with a double-layer amniotic membrane covering the leaking bleb

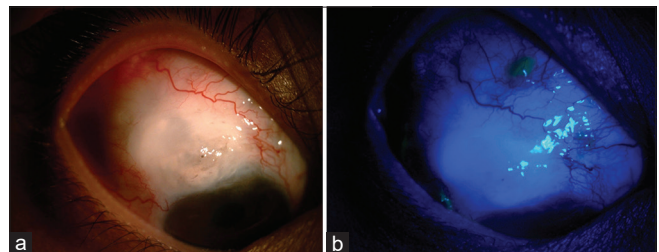


Figure 3: Photo of the right eye showing cessation of bleb leak with signs of vascularization and formation of cystic bleb postoperatively under diffuse illumination (a) and cobalt blue light with fluorescein stain (b)

because of bleb leakage. Hence, each leaking bleb should be managed promptly.^[1]

Initially, bleb leakage can be managed conservatively by aqueous suppressants, topical gentamycin, doxycycline, pressure bandage, Simmon's shell, bandage contact lens, autologous serum, trichloroacetic acid, argon laser, compression suture, or cyanoacrylate glue.^[1,4,6] If these methods fail, surgical repair of the bleb leak can be performed by excising the bleb and advancing the conjunctiva, with grafts such as amniotic membrane, pericardium, sclera, or Tenon used.^[1-4] Patients with a chronic bleb leak may also have preexisting visually significant cataracts. Performing cataract surgery in a large, avascular, thin wall, and leaking cystic bleb is

challenging. Our approach to counter these challenges is described here.

We advocate constructing a corneal incision and paracentesis port away from the bleb area. When performing surgery on posttrabeculectomy patients, particularly in cases where there is a bleb leak present, we recommend setting with lower fluidics, including lower infusion pressure, aspiration flow rate, vacuum settings, and phaco power to prevent further damage to the leaking bleb. To preserve bleb survival, it is essential to perform thorough cortical cleanup to prevent inflammation provoked by any residual cortical matter. In addition, it is important to exercise care and gentleness during intraocular lens insertion to minimize any iris manipulation.^[7]

Regarding the amniotic membrane, it is noteworthy that it is composed of three layers – the epithelium, basement membrane, and stroma with a thickness ranging from 0.02 to 0.4 mm. The basement membrane contains crucial substances such as fibronectin, laminin, and collagen IV, V, and VII, which facilitate cell adhesion and growth. On the other hand, the stroma, which comprises compact, fibroblast, and spongy layers, is responsible for providing growth factors such as endothelial growth factor, keratinocyte growth factor, and hepatocyte growth factor. In addition, the stroma plays a vital role in inhibiting transforming growth factor beta, cytokines, and protease activity, thereby promoting epithelization and reducing inflammation. It is also noteworthy that the amniotic membrane exhibits antibacterial properties, low antigenicity, and anti-scarring features.^[8-10]

The amniotic membrane serves as either a graft or patch depending on the orientation of its epithelium. When the epithelial side is oriented upwards, it functions as a graft by promoting conjunctival epithelization, migration, and adhesion of basal epithelial cells, stimulating epithelial cell differentiation, and preventing epithelial cell apoptosis. Conversely, when the epithelial side is oriented downward, it functions as a patch that protects the underlying layer from frictional forces caused by the eyelids and reduces inflammation. The sandwich technique, which involves using two layers of amniotic membranes, can be implemented by applying an outer layer with the epithelial side down over an inner layer with the epithelial side up [Figure 4]. The outer layer serves as a protective patch over the graft beneath.^[8-10] We performed double-layer amniotic membrane transplantation using the sandwich technique without excising the bleb or manipulating the surrounding tissue, as depicted in Figure 4.

The treatment performed in the case of the patient resulted in the successful resolution of the bleb leakage, which is a common complication that may

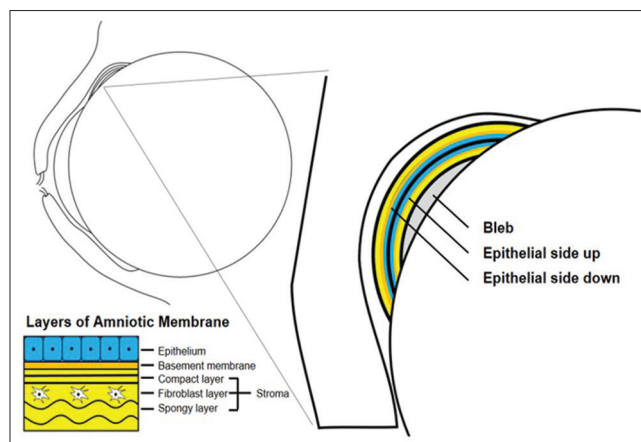


Figure 4: An outer layer of the amniotic membrane with the epithelial side down over an inner layer with the epithelial side up

arise after trabeculectomy surgery. The follow-up appointments conducted at 1 month, 6 months, and 1 year postoperatively showed that the bleb leakage had fully resolved. The patient’s vision in the right eye had also improved, with a best-corrected visual acuity of 6/24. Furthermore, the intraocular pressure of the patient remained stable within the range of 12–14 mmHg, which is a healthy level for intraocular pressure.

Conclusion

The patient’s successful treatment was accomplished using a range of strategies aimed at maintaining the bleb’s viability, preventing additional injury, and promoting successful wound healing. A feasible method for addressing persistent bleb leaks could involve performing a joint procedure consisting of low-fluidics cataract surgery and amniotic membrane transplantation while avoiding excision of the bleb. The implementation of these interventions yielded favorable outcomes for the patient, such as the complete resolution of the bleb leakage, improvement in visual acuity, and maintenance of targeted intraocular pressure levels.

Declaration of patient consent

The authors declare that they have obtained all appropriate patient consent forms. In the form, the patient has given her consent for her images and other clinical information to be reported in the journal. The patient understands that her name and initials will not be published and due efforts will be made to conceal her identity, but anonymity cannot be guaranteed.

Data availability statement

Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

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Conflicts of interest

The authors declare that there are no conflicts of interest in this paper.

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