Selected Descemet membrane endothelial keratoplasty (DMEK) combined with cataract surgery in a triple procedure has been demonstrated to be safe and cost-effective and can be considered in cases of endothelial failure and secondary corneal decompensation in which there is evidence of coexistent cataract.1,2 As visualization of anterior segment structures can be compromised by the presence of corneal edema or scarring, this has been demonstrated to increase the complication rate of phacoemulsification surgery.3 This risk remains when cataract surgery is combined with additional procedures, and in addition, complications at the time of cataract extraction can make the remainder of the planned surgery more challenging and limit the successful outcome.

We demonstrate the use of an older technique to cope with an intraoperative complication of cataract surgery combined with DMEK with a satisfactory outcome.

CASE REPORT

An 80-year-old man presented in August 2017 with corneal edema in the right eye of unclear etiology. He had no ocular history and reported no recent pain or photophobia. Examination revealed an edematous cornea in the right eye with Descemet folds and conjunctival injection. Visual acuity was counting fingers. He had a healthy-appearing cornea in the contralateral eye with no evidence of any form of endothelial dystrophy. He was initially treated with topical prednisolone acetate 1% (Pred Forte,) 4 times a day for 2 months and systemic antivirals (oral Aciclovir) 400 mg 5 times a day for 2 weeks. The patient then discontinued all topical and systemic treatment. The active inflammatory process resolved, but at 14 months after the initial presentation, he had persistent corneal edema and Descemet folds (Figure 1). He also had a visually significant cataract. His visual acuity remained at counting fingers. With informed consent, he underwent a corneal endothelial graft (DMEK) combined with cataract surgery in October 2018.

A 9.0 mm endothelial graft was prepared immediately before surgery and stained with 0.04% trypan blue (DORC). Before attempted phacoemulsification, the corneal epithelium was removed, and the corneal endothelium was removed under air to improve visualization. Trypan blue
(0.04%) was injected intracamerally to aid the capsulorhexis. Despite this, because of poor visualization of the nucleus, it was felt that there was an increased risk for posterior capsule rupture if phacoemulsification was continued. Therefore, the procedure was converted to extracapsular cataract extraction (ECCE). The main superior limbal wound was extended from 2.75 mm to approximately 8.0 mm. The decision was made to extend the existing wound rather than create a new wound to minimize the number of wounds created and aid anterior chamber stability when the DMEK graft was injected. The nucleus was expressed, and cortical matter was removed with a simcoe cannula. A 3-piece intraocular lens (MA60AC, Alcon Laboratories, Inc.) was inserted into the ciliary sulcus. The main wound was then partially closed with 10-0 nylon sutures with enough space left between 2 sutures to allow injection of the DMEK graft. The graft was injected into the anterior chamber using a glass injector (DORC). It was then unfolded and positioned centrally under air using the standard no-touch technique as described by Dapena et al. On day 1 post-operatively, he had an attached DMEK graft with no evidence of interface fluid (Figure 2, A and B). Postoperative treatment consisted of preservative-free topical dexamethasone 0.1% 4 times a day, topical preservative-free chloramphenicol 0.5% 4 times a day, and oral aciclovir 400 mg 5 times a day. He had an uneventful postoperative recovery with no graft detachment, and all corneal edema had resolved by 2 months (Figure 2, C and D). At this time, sutures were removed. Three months postoperatively, his graft was clear with a corrected visual acuity of +0.2 logarithm of the minimum angle of resolution (Snellen equivalent 20/32), with a postoperative refraction of 0/+2.00 × 180 (Figure 2, E and F). Topical dexamethasone was tapered over 2 months to a maintenance dose of once a day, topical chloramphenicol was discontinued after 2 months, and oral aciclovir was reduced to a maintenance dose of 400 mg twice a day after 2 weeks. Histopathology analysis of the host endothelium showed Descemet membrane of normal thickness with only occasional attenuated endothelial cells. This was consistent with endothelial failure but could not provide a definitive underlying etiology.

**DISCUSSION**

Combining corneal endothelial graft (DMEK) with cataract surgery in a triple procedure in the presence of lens opacity has been demonstrated to be safe and cost-effective. It allows for faster visual rehabilitation and reduces the risk for endothelial cell loss or graft damage with further cataract surgery. It has been associated with more frequent postoperative graft dislocations requiring rebubbling and postoperative hyperopic shift.
Phacoemulsification surgery requires visualization of anterior segment structures to avoid complications including posterior capsule rupture, which may necessitate anterior vitrectomy and preclude a standard intraocular lens placement. In cases in which the cornea is edematous or in the presence of opacity, pre- and perioperative optimization of view is required. Intraoperatively, this can include debridement of the corneal epithelium, staining of the anterior capsule with ophthalmic dye before performing capsulorhexis, and operating microscope adjustments or endoillumination. Topical glycerine can also be used to temporarily improve corneal clarity during surgery. When combined with corneal epithelium debridement, the endothelium may be removed before commencing phacoemulsification to also improve surgical view. If an adequate view is not possible, penetrating keratoplasty performed as part of a triple procedure can be considered. This traditional triple procedure has a longer postoperative recovery time course and carries higher risk for graft rejection, expulsive hemorrhage, and astigmatism than a corneal endothelial graft. When standard cataract surgery alone is required and there is a poor view of the lens through the cornea, the surgical approach can be altered by planning for initial ECCE. This requires a larger wound than standard phacoemulsification and can result in a greater degree of astigmatism. In addition, the current cohort of cataract surgeons have less experience with this technique as advances in phacoemulsification mean it is rarely performed.

Descemet membrane endothelial keratoplasty can be considered in combination with cataract surgery where appropriate visualization of the lens to allow for safe cataract surgery is possible. However, in some cases, the intraoperative view is not as expected during preoperative assessment. In the United Kingdom, donor corneal tissue for DMEK is provided by NHS Blood and Transplant eye bank and expires within 24 hours of delivery. Once the graft is prepared, it should be used immediately or discarded, which would waste human graft tissue.

If difficulties arise once the anterior lens capsule has been breached, abandoning the procedure risks uveitis, phacolytic glaucoma, and poor visual outcome. Therefore, once the capsulorhexis has been commenced, it usually becomes incumbent to complete the cataract extraction. If techniques to visualize the lens and anterior chamber clearly fail, or if the view deteriorates intraoperatively due to incipient corneal edema, the surgeon can choose to persevere, with a greater risk for complication, postpone completion of the procedure, or extend the corneal incision and express the lens by converting to an extracapsular technique. The chief surgical challenge if extending the corneal incision when performing DMEK is safe and successful subsequent graft insertion and positioning. The larger corneal incision could result in expulsion of graft tissue from the anterior chamber with resultant endothelial trauma. A larger wound could also result in an unstable anterior chamber, meaning that it collapses during graft unfolding and positioning. An irregular internal corneal surface onto which the endothelial graft is attached may also result in resultant graft dislocations peri- or postoperatively. By placing interrupted corneal sutures to partially close the wound, this stabilizes the anterior chamber enough to support successful graft placement. There would be expected to be greater refractive error with an extension of the wound and corneal sutures. However, this is less than when compared to performing penetrating keratoplasty.

In our case, we removed both the endothelium and the epithelium to improve clarity and used trypan blue to stain the anterior capsule. We did not have access to topical glycerine or equipment to provide endoillumination. It was felt intraoperatively that the potential risks of performing ECCE were less than persevering with standard phacoemulsification. In this case, there was an increased risk for posterior capsule rupture, which may have resulted in a dropped nucleus. It was felt that trying to perform DMEK in the context of a compromised posterior chamber and the need for subsequent vitrectomy in the context of an edematous cornea carried a greater risk for graft failure and poor visual outcome for the patient.

This article describes an alternative surgical method of handling a potentially challenging case in the presence of intraoperative corneal edema that allows a good visual outcome. Poor visualization of the anterior chamber during triple procedure DMEK surgery may necessitate a change in surgical planning and does not preclude a successful outcome. This may include extracapsular extraction, and all cataract surgeons should be prepared to convert if necessary.

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