Advances in endothelial keratoplasty

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Chapter 6

Descemet Membrane Endothelial Transfer: Ultimate Outcome

Cornea 2018;37:141-4

ABSTRACT

Purpose: To evaluate the clinical outcome of 16 eyes undergoing Descemet membrane endothelial transfer (DMET).

Methods: In this retrospective cohort study, a consecutive series of 16 eyes from 16 patients was evaluated after subtotal detachment of the Descemet graft after a Descemet membrane endothelial keratoplasty procedure (n=8) or intended DMET (n=8) for either Fuchs endothelial dystrophy (FED; n=10) or Bullous keratopathy (BK; n=6).

Results: All 8 Descemet membrane endothelial keratoplasty procedures were complicated by subtotal detachment of the donor graft. The remaining 8 eyes that underwent a DMET procedure were uneventful and no postoperative complications occurred, except 1 eye with BK that experienced a postoperative wound leak. Throughout all postoperative time points, the partially attached status of all Descemet grafts was maintained. Although all eyes operated on for FED showed initial central corneal clearance, no eye operated for BK demonstrated any degree of corneal deturgescence. Ultimately, all 16 corneas decompensated and 15 of the 16 patients elected for re-transplantation, while one patient declined further surgery for health reasons. Re-transplantation was performed on average 10.3 (±7.4) months (range, 3-31 months) postoperatively.

Conclusion: Ultimately, regardless of the etiology of the endothelial dysfunction, DMET fails to provide satisfactory results in the long term; durable corneal clearance may therefore require the presence of a nearly completely attached Descemet graft.

INTRODUCTION

Since its introduction in 2002, Descemet membrane endothelial keratoplasty (DMEK) has increasingly become the globally preferred surgical treatment option for patients with corneal endothelial disorders.[1] More recently, we reported on 'Descemet membrane endothelial transfer' (DMET), in which a descemetorhexis is followed by insertion of an almost completely free-floating Descemet roll (i.e. with the graft contacting the posterior cornea only at the corneal incision) aiming to obtain corneal clearance by endothelial cell migration.[2,3]

Our initial evaluation of DMET comprised a cohort of 12 eyes from 12 patients, 7 operated on for Fuchs Endothelial Dystrophy (FED) and 5 for Bullous Keratopathy (BK). The short-term results showed repopulation of the denuded recipient stroma and corneal clearance in all eyes operated on for FED, but not for those with BK.[2,3] Since then, 4 additional eyes have undergone a DMET procedure; this study aims to provide the further results of this cohort.

MATERIALS AND METHODS

A consecutive series of 16 eyes from 16 patients (6 female; mean age of 62.8 ±[16.9] years) underwent DMET for either FED or BK (3 with pseudophakic BK, 2 with decompensated previous endothelial grafts, and 1 of unknown origin) in our tertiary referral center between February 2008 and September 2012. All patients signed an informed consent form for research participation, and the study was conducted according to the tenets of the Declaration of Helsinki.

Eight eyes underwent a DMEK procedure, subsequently complicated by a subtotal graft detachment in the immediate postoperative period, such that the greater portion of the graft was "free-floating" in the anterior chamber. In the remaining 8 eyes, various complicated anatomical situations (including nanophthalmos, histories of advanced glaucoma, unstable or dislocated intraocular lenses, or a combination thereof) resulted in an anticipated inability to provide air bubble support for the tissue at the end of surgery. Therefore, during the DMEK operation, the upper edge of the graft was fixated within the limbal incision to create contact between the donor tissue and the recipient posterior stroma.

Donor tissue preparation was performed as previously described.[4,5] In short, from donor globes retrieved within 36 hours postmortem, corneoscleral buttons were excised and stored in organ culture medium (CorneaMax; Eurobio, France) at 31°C for up to 3 weeks. The buttons were mounted endothelial side up on a custom-made holder with a suction cup to facilitate stripping of a 9.5 mm-diameter Descemet graft. Owing to its elastic properties, the graft spontaneously formed a single or double roll with the endothelium on the outside. After preparation, all Descemet rolls were stored again in organ culture medium until transplantation. Endothelial cell morphology and viability were evaluated in the eye bank before and after Descemet stripping.

Surgery was performed as previously described.[6] Eight of the 16 operations were completed as normal DMEK procedures; in the remaining 8 (with anticipated insufficient or ineffective air bubble support), the operation additionally included fixating the proximal edge of the graft within the limbal incision to ensure contact between the donor tissue and the recipient posterior cornea. Postoperative medical therapy included chloramphenicol 0.5% (6 times daily during the first week and twice daily during the second week), ketorolac tromethamine 0.4% 4 times daily and dexamethasone 0.1% 4 times daily, switched to fluorometholone 0.1% 4 times daily at 1 month, then reduced to 3 times daily at 3 months, 2 times daily at 6 months and once daily at 9 months postoperative.

Before and after surgery, corneal thickness measurements were obtained by Scheimpflug imaging (Pentacam HR; Oculus, Wetzlar, Germany), and endothelial cell density (ECD) measurements were made preoperatively in the eye bank, *in vitro*, using an inverted light microscope (Axiovert 40; Zeiss) and after surgery, using non-contact specular microscopy (Topcon SP3000; Topcon Medical Europe BV, Capelle a/d IJssel, the Netherlands).

RESULTS

All 8 DMEK procedures were complicated by a subtotal detachment of the donor graft. The remaining 8 eyes that underwent a DMET-procedure were uneventful and no postoperative complications occurred, except one eye with BK that experienced a postoperative wound leak. Throughout all postoperative time points, the partially attached status of all DMET grafts maintained; that is, in no case did any graft entirely adhere or totally detach spontaneously.

Ultimately, all 16 corneas decompensated and 15 of the 16 patients elected for re-transplantation, whereas one patient declined further surgery for health reasons. Re-transplantation was performed on average 10.3 (±7.4) months (range, 3-31 months) postoperatively.

All eyes operated on for FED (n=10) initially showed central (partial) corneal clearance, with a reduction in mean thinnest point pachymetry from 636 (±89) µm to 533 (±47) µm by six months postoperatively (n=6) (Fig. 1). Six of these 10 also improved their best-corrected visual acuity, although most of these eyes possessed low visual potential secondary to pre-existing retinal pathology. However, mean endothelial cell density measured at 6 months postoperatively was 797 (±743) cells/ mm^2 (n=6) and, ultimately, all 10 corneas decompensated (evidenced by decreasing vision and increasing corneal thickness), such that – at a mean of 11.6 (±9.2) months (range, 4-31 months) postoperatively – 9 of these 10 eyes received re-transplantation, with 1 patient declining additional surgery for health reasons.

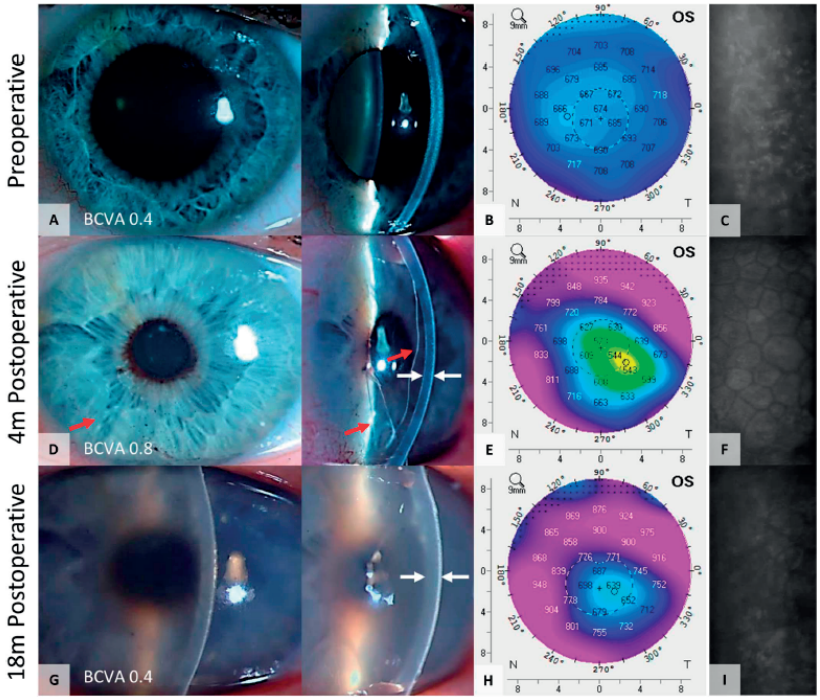

Figure 1. Slit-lamp images, pachymetry and specular microscopy preoperatively (A, B and C), at 4 months (D, E and F) and at 18 months after Descemet membrane endothelial transfer (G, H and I). Note the initial corneal clearance at 4 months and the corneal decompensation at 18 months postoperatively (white arrows). The red arrows display the borders of the Descemet graft.

By contrast, at no time point did any eye operated for BK demonstrate corneal clearance, measured by reduction in corneal thickness or a subjective improvement in vision (mean preoperative and 6 months postoperative thinnest point thickness 768 (±104) μm and 777 (±133) μm, respectively (n=5)). All 6 eyes were subsequently managed by re-transplantation at a mean of 8.3 (±3.6) months (range, 3-14 months) postoperatively.

DISCUSSION

In the past decade, a growing number of studies describing spontaneous corneal clearance in the presence of a detached Descemet graft[2,7-9] or in the absence of a Descemet graft, that is, 'descemetorhexis only'[10-21] have challenged the current concept of endothelial keratoplasty and questioned the necessity of grafting after descemetorhexis. Many of these studies have emphasized the short-term surgical results, including our own previous report on the efficacy of DMET.[3] Moreover, negative results have also been described, with a significant number of corneas failing to clear having been reported following "descemetorhexis only" procedures.[10,11,13,15,22,23]

The current study confirms that DMET may engender corneal clearance in eyes with FED, but not BK. This suggests that the mechanism of action of DMET may be primarily to stimulate a host endothelial migratory response, rather than to directly supply the transplanted eyes with additional functional cells. Nevertheless, our observations with DMET would suggest that the regenerative capacity of the endothelium in eyes with FED may not be sufficient to ensure lasting corneal clearance since all operated eyes experienced only partial and transient – not complete and durable – corneal deturgescence. This limited and transitory capacity of the recipient endothelium to self-repair in eyes with FED may explain why the reported success of "descemetorhexis only" strategies presently seems dependent on a small, central descemetorhexis, exclusively.[24] It may also explain the mechanism behind instances of corneas prematurely decompensating after DMEK in the presence of a large persistent graft detachment.[25] Accordingly, to obtain complete and lasting corneal rehabilitation, a (nearly) fully centrally attached Descemet graft may be mandatory. A further implication is that very large DMEK graft detachments, especially if greater than half the tissue surface area, may be best managed by re-bubbling, rather than by awaiting spontaneous corneal clearance, to minimize the risk of a subsequent corneal decompensation.[26]

Therefore, the current practice of DMEK may remain the preferred treatment option for the long-term management of corneal endothelial disorders, both FED and BK.

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