Wound-assisted air injection in Descemet Stripping Automated Endothelial Keratoplasty

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ABSTRACT

Background: Early postoperative graft detachment remains one of the most common complications of DSAEK. Objectives: To describe a modification of a simple method to facilitate a firm AC, without a leak, during DSAEK. Method: Ten consecutive DSAEK surgeries were reviewed. Surgery was performed by a single surgeon (HA). At the beginning of surgery, a trapezoid paracentesis was made at the limbus using a 20G MVR blade. The trapezoid incision was made by inserting the blade halfway, creating a cut with an internal opening half the width of its external opening. After inserting the corneal disc and suturing the main incision, air was injected with a 25G tapered hydrodelineation cannula. The tip was engaged at the trapezoid paracentesis and did not enter the anterior chamber. A firm, full air bubble was formed in the anterior chamber, and no leaking occurred at the paracentesis site, which acted as a one-way valve. Results: All grafts were adhered from the first day after surgery, and no dislocations were observed. All corneas were clear at the one-month postoperative visit. Conclusions: Wound-assisted air injection is a safe, effective, simple method for achieving a firm air bubble during DSAEK, potentially reducing dislocation rates.

1. Introduction

Descemet Stripping Automated Endothelial Keratoplasty (DSAEK) and Descemet Membrane Endothelial keratoplasty (DMEK) are techniques indicated for endothelial dysfunction associated with visual loss, disability, and pain. While DMEK is gaining popularity, DSAEK is still commonly used. The DSAEK surgical technique is based on four major steps: preparation of a thin donor corneal lenticule graft; stripping of the recipient’s Descemet membrane; insertion of the lenticule graft through a scleral/corneal tunnel; and attaching the graft to the recipient cornea with a gas bubble. Our aim in DSAEK is to fully tamponade the anterior chamber with air or gas (such as SF6), raising the intraocular pressure (IOP) above 30 mmHg, but not higher than 50 mmHg. Early postoperative graft detachment remains one of the most common complications of DSAEK, with reported rates from 0 to 82% and an average dislocation rate of 14.5%. The most common reason for a graft not properly attaching to the host cornea is believed to be the lack of a tight, full air bubble lasting at least 15 minutes. The dislocation rate is even higher in eyes that are aphakic, vitrectomized, have extensive corneal decompensation, a tendency toward postoperative ocular hypotony, or have undergone a large sector iridectomy or glaucoma tube shunt device implantation.

In order to facilitate a firm AC without a leak, our group modified the surgical technique by creating a special corneal paracentesis that functions as a one-way valve, thus creating a firm air bubble in the anterior chamber. This study aims to describe the technique and to report our experience.

2. Materials and methods

All data for the study was collected and analyzed in accordance with the policies and procedures set by the Institutional Review Board of the Edith Wolfson Medical Center and the tenets of the Declaration of Helsinki (WOMC-0043-17). The requirement for patient consent was waived because patient data were anonymized.

2.1. Study participants

This retrospective study included ten consecutive patients who underwent DSAEK, performed by a single surgeon (HA) at the Department of Ophthalmology, Edith Wolfson Medical Center, 62 Halochamim St., Holon, 58100, Israel. E-mail address: lironbh4690@gmail.com (L. Naftali Ben Haim).
of Ophthalmology, Edith Wolfson Medical Center, Holon, Israel, between April 2014 and October 2017.

2.2. Data collection

All patients’ medical files and surgical reports were reviewed, and the following demographic and preoperative information was extracted, maintaining the patient’s anonymity: age, gender, date of surgery, operated eye, indication for surgery, past ocular surgery, BCVA, and IOP. The following intra- and postoperative information were also collected: anesthesia type, duration of surgery, duration of air tamponade, and BCVA after surgery.

2.3. Statistical analysis

Data was collected and analyzed in an Excel spreadsheet (Microsoft Excel for Office 365 MSO (16.0.11901.20070) 32-Bit).

2.4. The surgical technique

At the beginning of surgery, a trapezoid paracentesis was made at the limbus to inject air, assisting the graft insertion (Fig. 1). This trapezoid incision was made by inserting a 20G MVR blade halfway, creating a cut with an internal opening half the width of its external opening. Subsequently, a 5.5 mm sclero-corneal incision was made at 100° followed by two additional small paracentesis. Then, scoring and descementorhexis were performed using a reverse Sinskey hook under anterior chamber maintainer flow. The lenticule graft was then folded and introduced through the main incision by sliding it over a plastic glide with a 30-gauge bent needle. After graft insertion, the main incision was sutured, and the graft was unfolded and centered. Air was injected through the dedicated trapezoid incision with a 25G tapered hydrodelineation cannula (BD Visitec™ tapered Hydrodelineator Cannula [Blumenthal]), engaging the tip at the trapezoid paracentesis and not entering the anterior chamber. Video 1 shows the efficacy of air injecting through the dedicated trapezoid one-way valve incision compared to regular paracentesis. A firm, full air bubble was formed in the anterior chamber. The air bubble filled the anterior chamber for at least 15 minutes, depending on the patient’s characteristics.

Supplementary video related to this article can be found at https://doi.org/10.1016/j.jaoc.2022.101290

3. Results

Overall, DSAEK surgery with the modified one-way valve paracentesis was reviewed for ten patients. Eight of them were female, with a mean age of 78.5 ± 11.1 years. Six patients had pseudophakic bullous keratopathy (PBK), three had failed DSAEK grafts, and one had Fuchs’ endothelial dystrophy. All patients were pseudophakic at the time of surgery, nine with posterior chamber intraocular lenses (IOL) and one with an anterior chamber IOL. Two patients had undergone trabeculectomy surgery, and one had cyclo-photocoagulation. Surgery was done under general anesthesia in three patients and local anesthesia in seven patients (topical, subconjunctival, or subtenon lidocaine 2%). The air bubble filled the anterior chamber for 15–20 minutes, followed by partial air-fluid exchange in seven patients. In the other three patients (two prior trabeculectomies, one with AC IOL), the full air bubble was left as-is at the end of surgery. The mean duration of surgery was 37.75 ± 7 minutes. Mean preoperative BCVA improved from 1.77 ± 0.44 logMAR to 0.58 ± 0.25 logMAR (p = 0.0001) at 6.1 ± 3.2 months of follow-up.

All grafts were adhered the day after surgery, and no dislocations were observed. One patient had transient elevated IOP, which was resolved by anterior chamber paracentesis. All corneas were clear at the one-month postoperative visit.

4. Discussion

DSAEK still remains the procedure of choice for many patients with endothelial decompensation, especially in complicated cases. The most common complication of DSAEK is inadequate air tamponade that leads to graft detachment. Several methods and techniques to lower the dislocation rate have been reported in the literature. Our method of making a trapezoid incision is a safe and effective way to achieve a firm air bubble in the AC. The technique is simple, straightforward, and can be applied without changing the surgical protocol.

Aiming to avoid air leakage during AC air inflation, Liang et al. modified their technique, using continuous air pumping to achieve complete air retention of the AC. They managed to achieve a low graft dislocation rate (as low as 1.3%) by using venting incisions and a complete AC air fill. The trapezoid incision method laid out in the current study allows for complete AC air fill and may aid in graft and interface fluid removal, necessary for preventing graft dislocation. Our trapezoid incision method may also support the method of corneal massage (surface stroking) suggested by Price et al. and Paul et al. Corneal massage, using a LASIK flap roller to swipe the corneal surface while the graft is in place and the AC is filled with air, is performed to remove residual fluids trapped in the graft-host interface. Using a trapezoid incision to create high pressure in the AC may promote graft adherence: massaging against higher IOP (~60 mmHg) is necessary to facilitate the egress of fluids, but massaging against lower IOP (~30 mmHg) leads to corneal deformation and graft separation. Finally, the trapezoid incision might also be used to reduce iatrogenic graft damage since air is injected with the cannula tip engaged at the

![Fig. 1. Trapezoid (left) versus rectangular (right) paracentesis.](https://doi.org/10.1016/j.jaoc.2022.101290)
trapezoid paracentesis, outside the AC. Subsequently, the air bubble can levitate, vaulting the graft against the recipient host bed without unintentional damage to the endothelial cells.\textsuperscript{13}

This study has several limitations. First, the study was performed on a small sample of patients, was retrospective, and had no control group. Second, the surgical technique was performed by a single surgeon (HA): it is important to examine the results of other surgeons applying the same technique. It is also noteworthy that any small paracentesis can generally result in an airtight wound, providing it is small enough to achieve this goal. However, a simple modification of the paracentesis to act as a one-way valve could potentially be more robust in minimizing leakage during air inflation.

In conclusion, we presented a modification of the surgical technique for DSAEK, incorporating a trapezoid wound-assisted air injection to achieve a firm air bubble. We find this method to be safe and straightforward to prevent dislocation. Potentially, this method may also be used in other cases where a complete AC fill is warranted (as in DMEK, rebubbling, or Descemet’s detachment post-cataract surgery). The trapezoid incision can help the graft become firmly attached to the host cornea due to the pressure of the air injected through it, which will be trapped in the AC and assist in the drainage of the remaining interface fluid.\textsuperscript{14}

**Ethics approval**

All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards (WOMC-0043-17). The requirement for patient consent was waived because patient data were anonymized.

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**Declaration of competing interest**

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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