

Descemet Stripping Automated Endothelial Keratoplasty (DSAEK) Outcomes in High-Risk Patients

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Research Article

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Abstract

Purpose

To evaluate the results, survival rates, and proportion of complications related to Descemet Stripping Automated Endothelial Keratoplasty in high-risk patients.

Methods

Thirty-three patients (thirty-four eyes) who underwent DSAEK surgery between 2015 and 2019 were included in this retrospective, observational study. All participants were considered high-risk patients with a history of previous glaucoma surgery with glaucoma drainage device, previous graft failure, previous anterior chamber intraocular lens, or glaucoma with an indication of corneal surgery.

Results

After 7.1 months of follow-up (range from 1 to 35.9 months), seventeen eyes (50%) had graft failure. Among those, eight eyes (47%) belonged to the previous graft failure group, and seven eyes (41%) had a glaucoma drainage device in the anterior chamber. Although best-corrected visual acuity (BCVA) did not improve significantly postoperatively ($p = 0.112$), twelve eyes improved their visual acuity, and fifteen eyes remained unchanged. The percentage of eyes with BCVA of 20/40 or better improved from 11% preoperatively to 26% postoperatively. The most common surgical complication was lamellae dislocation, occurring in six eyes.

Conclusions

Adverse outcomes are highly common in high-risk patients who receive a DSAEK, especially in those patients for whom a graft previously failed or with a glaucoma drainage device. The most common complication was graft detachment, with a rate similar to other reports in non-high-risk patients. In our series, previous graft failure is a higher risk factor than a GDD.

Introduction

The concept of posterior lamellar keratoplasty was first described by Tillet in 1956,¹ but failed to gain traction in the field due to its association with poor visual outcomes. Melles returned to the concept in 1988, achieving successful results for the first time.² In the last decade, among corneal surgeons, there is a tendency to perform endothelial keratoplasty (EK) due to the faster visual recovery, less induced astigmatism, and fewer complications than with penetrating keratoplasty.³ According to a publication by

the Eye Bank Association in 2016, 57% of all corneal transplants in the United States were EKs.⁴ This trend is especially pronounced in developed countries.⁵

Descemet Stripping Automated Endothelial Keratoplasty (DSAEK) is a type of endothelial posterior lamellar transplant in which the corneal endothelium and Descemet's membrane are selectively removed from the patient; the endothelium, Descemet membrane, and a thin layer of the posterior stroma are then transplanted. While recently-published studies have evaluated the results of DSAEK in Fuchs endothelial dystrophy and pseudophakic bullous keratopathy, there is little information about the outcomes of DSAEK in high-risk populations. While an exact definition of a "high-risk" DSAEK patient has not been proposed, high-risk patients most likely include those with severe glaucoma with previous or combined glaucoma drainage device (GDD), previous graft rejection, and anterior chamber intraocular lenses (IOLs).

The *Asociación para Evitar la Ceguera en México* (Mexico Association to Prevent Blindness) first incorporated the DSAEK technique into their surgical procedures in 2015. As a reference hospital in corneal transplantation, the Association habitually receives complex cases with multiple ocular comorbidities such as glaucoma. We sought to better understand the outcomes that our high-risk patients were having after DSAEK through a retrospective study to report their visual outcomes, complications, and graft survival.

Materials And Methods

This retrospective, observational study was conducted with APEC data from 2015 to 2019. The study adhered to the tenants of the Declaration of Helsinki and Institutional Review Board approval was obtained prior to the retrospective review of the data. All medical records of patients with endothelial failure who had received DSAEK surgery were reviewed. All included patients were high risk, defined as having a previous glaucoma diagnosis with previous GDD, previous graft failure, previous anterior chamber phakic IOL, or combined DSAEK surgery with GDD.

Surgical technique

A group of cornea specialists—made up of one experienced surgeon and six fellows—performed the procedures; the most experienced surgeon participated as either first or second surgeon in all surgeries. The implantation was performed by a glaucoma specialist in cases of combined simultaneous surgery with GDD implantation. All donor corneas were stored in Optisol GS (Bausch & Lomb Incorporated, Rochester, NY, USA) provided by Lions Eye Bank. The endothelial counts were > 2500 cell/mm². All surgeries were performed under local anaesthesia. The DSAEK lamella was prepared with the Moria ALTK system (Moria, Antony, France) to a diameter of 8.0 mm. Twenty-nine cornea lamellae were cut by the surgical staff, while the rest were acquired directly from the eye bank as pre-cut tissue. The posterior lamella graft was introduced to the anterior chamber with the help of a Busin slider and microincision forceps. After obtaining an adequate lamella position, a large air bubble was injected to keep the donor tissue in full contact with the recipient cornea, leading to transient intraocular hypertension. After 20

minutes, the air bubble was reduced to achieve normal intraocular pressure (IOP). In cases where lamella adherence could not be obtained, a transfixing suture was placed through the donor lamella.

Follow up

Clinical follow-up visits were held one day; one week; two weeks; and one, three, six, and twelve months after the procedure. As part of routine care, a complete ophthalmologic examination was performed on all patients. The data extracted and analysed for this study included age, sex, type of surgery (DSAEK, DSAEK + cataract phacoemulsification, DSAEK + GDD), best-corrected visual acuity (BCVA) measured with logMAR chart, lamellar adherence status, and corneal transparency. The presence of graft failure and the need for rebubbling or lamellar suture was recorded. Primary graft failure (PGF) was defined as a graft that never achieved transparency during the first four weeks, and secondary graft failure (SGF) was defined as an initially clear cornea that became opaque and maintained this condition for 90 days.

Statistical Analysis

Data was recorded into spreadsheets using Numbers for Mac (Ver. 3.6.2. Apple, California. USA). Statistical analysis was performed with SPSS (Ver. 22. IBM Corp. Armonk, USA). Continuous variables were compared with a Mann–Whitney U test, and categorical data were compared with a chi-square test. P values ≤ 0.05 were interpreted as statistically significant.

Results

Demographics

Thirty-four eyes belonging to thirty-three patients were included; one patient received a second DSAEK after his first procedure failed. The overall mean age of patients was 64 years (range: 35–89). Nineteen cases (58.8%) were male, and fifteen cases (42.2%) were female.

The most common diagnosis was previous graft failure in fourteen cases (ten for penetrating keratoplasty, three for DSAEK, and one for DMEK). The procedure most commonly performed in combination with DSAEK was cataract extraction with IOL implantation in ten patients. Previous GDD was present in thirteen cases; a combined surgery of DSAEK with GDD was performed in four cases. Two phakic anterior chamber PMMA intraocular lenses were extracted, and one anterior chamber IOL was left inside the eye in one case. All patient demographic data are shown in Table 1.

Table 1
Demographic characteristics

Parameter	
Age (years) mean (DE, min a max)	64 (59.25–75.75)
Gender % (n)	55.8% (19) males 44.2% (15) females
Preoperative diagnosis. % (n)	Previous Ahmed valve implantation 38.2% (13) Combined DSAEK with Ahmed valve implantation 11.7% (4) Previous PKP failure 29.4% (10) Previous DSAEK failure 8.8% (3) Previous DMEK failure 2.9% (1) Previous anterior chamber phakic IOL 8.8% (3)
Surgeon % (n)	Senior Consultant 67.6% (23) Fellow 32.3 % (11)

Visual acuity

Preoperatively, the mean BCVA was 1.09 logMAR (SD \pm 0.44); twenty-four eyes (70%) had a BCVA of 1 logMAR or worse (20/200 in Snellen), and four (11%) had a BCVA of 0.3 logMAR or better (20/40 in Snellen). Postoperatively, the mean BCVA was 1.00 logMAR (SD \pm 0.58), with eighteen eyes (52%) having a BCVA of 1 logMAR or worse and nine eyes (26%) having a BCVA of 0.3 logMAR or better (Fig. 1). The BCVA improved in twelve patients, remained unchanged in fifteen, and became worse in seven patients because of graft failure. Of these patients whose BCVA dropped, five had a previously-failed graft and two had previous glaucoma. Overall, the improvement of BVCA was not statistically significant ($p = 0.112$).

Graft survival and postoperative complications

The mean follow-up time was 7.1 months (range 1-35.9 months). The most common factors limiting postoperative vision—other than advanced glaucoma—were graft failure in seventeen eyes (50%), PGF in fifteen eyes, and SGF in two eyes (Fig. 2). In the subgroup of previous graft failure, six eyes (42%) presented PGF, and two eyes (14%) presented SGF. In the subgroup of patients with previous GDD, seven eyes (53%) presented PGF. In six eyes with prior GDD, the graft was sutured to the host cornea with a transfixing suture because tamponade could not be obtained; two of these grafts failed. In the subgroup of concomitant surgery with GDD, one eye (25%) presented PGF, and in the subgroup of anterior chamber

intraocular lens, one eye (33%) presented PGF. Except for the previous graft failure subgroup, none of the other groups presented SGF (Table 2).

Table 2
Graft failure in subgroup of patients

	Eyes treated	PGF	SGF
Previous graft failure	14	6 (42%)	2 (14%)
Previous GDD	13	7 (53%)	0
Combined surgery DSAEK + GDD	4	1 (25%)	0
Anterior chamber IOL	3	1 (33%)	0
Total	34	15 (44%)	2 (5.8%)

Overall, six eyes (17%) presented with lamella dislocation; three of them were treated with rebubbling and three with suturing of the graft. From these six eyes with dislocation, three (50%) presented PGF after the treatment (Fig. 3).

Glaucoma

Of the seventeen eyes requiring topical hypotensive drugs for glaucoma control before the surgery, two eyes (11%) required an increased number of medications after the surgery. One patient with no history of glaucoma began therapy after DSAEK.

Discussion

There is no controversy that posterior lamellar keratoplasty is today the gold standard in endothelium transplantation. It has been the procedure of choice because of its advantages over PK, such as higher survival rates and fewer surgery-related complications. Still, most published studies have reported results in moderate- to low-risk conditions, such as pseudophakic bullous keratopathy or Fuchs endothelial dystrophy.^{6,7} We report 34 eyes with a history of high-risk conditions, such as previous graft failure, anterior chamber IOLs, glaucoma surgery (tube shunt, trabeculectomy, or transscleral cyclodestructive procedures), or any anomaly that may complicate surgery or postoperative evolution.^{8,9}

Although primary and secondary graft failure are commonly-described DSAEK complications, there is little information regarding these complications in high-risk patients. Lee et al. found primary graft failure to be the third most common DSAEK complication in the reviewed literature, with a range of 0–29% and an average PGF rate of 5% among all published studies, but not considering high-risk patients.⁷ In patients with previous graft failure, we reported a PGF of 42% and SGF of 14%. Einaun et al. reported 50% of graft failure in a group of DSAEK in previous failed PK, similar to our subgroup of patients with prior graft rejection.¹⁰ In eyes with previous GDD and DSAEK, Aldave et al. reported a PGF of 8.2% and SGF of

18%.¹¹ Similarly, Kang reported that 35% of patients with previous trabeculectomy and GDD who underwent DSAEK experienced an SGF.¹² Our PGF in patients with previous GDD was 53%, with no SGF during the follow-up. Hernstadt et al. reported that GDD patients experienced an initial survival graft rate at 12 months comparable to DSAEK with no GDD. However, graft survival declined significantly, such that the survival rate was 75% by 24 months and 63% by 36 months.¹³

Providers should exercise additional caution in cases of previous GDD or concomitant GDD. Surgeons must more closely monitor the length of the tube, the angle of insertion, and the tube's location. Also, maintaining air tamponade and the graft attached is more challenging in eyes with previous glaucoma surgery or vitrectomy as it is easier for the injected air to migrate into a vitrectomized posterior chamber or through a fistula. In six cases where an air bubble could not be retained in the anterior chamber, a transfixing suture was passed through the transplanted tissue; two of these cases subsequently failed.

Another relatively frequent complication was graft dislocation. Overall, we reported six cases (17%) of graft dislocation, three of which were successfully treated with air rebubbling or transfixing suture. Some authors report a dislocation rate from 5–20%.^{6,14,15} Specifically, a rate of 18-35.7% has been reported in patients with GDD,^{11,1} and of 25% in patients with previous graft rejection.¹⁰

The fact that there is a steep learning curve in regard to this type of surgery should be considered when analysing surgical complications like graft detachment. Aldave et al. reported complications in 23 and 13 of the first 100 cases performed by each surgeon (18.0% average) and in 20 of 261 subsequent cases (7.7% average).¹¹ This learning curve must be considered even more in patients with high-risk conditions, for example, cases where a tube must be repositioned or implanted, or a concomitant anterior segment surgery must be performed. Our surgical group was made up of first or second-year fellows assisted by an experienced surgeon. Evidence suggests that poor surgical technique, the use of specific surgical steps that are inherently more traumatic, and excessive tissue handling due to surgeon inexperience are all associated with higher PGF risk. There is also a learning curve in cutting the donor cornea with a microkeratome to produce a lamella graft. It should be noted that in this study, our surgical team prepared the lamella graft for 29 eyes (85.2%).¹⁶

Further studies with a higher number of patients and longer follow-up need to be done to support more efficient and effective clinical decision-making. Furthermore, more attention should be made to improving the learning curve in these difficult cases, as this could reduce the high rate of PGF. Our study suggests that high-risk DSAEK presents an elevated percentage of PGF with minimum improvement in BCVA. The most common complication was graft detachment, with a rate similar to other reports in non-high-risk patients. In our series, previous graft failure is a higher risk factor than a GDD.

To summarize, the present study shows anatomic and visual results, survival rates, and complications in high-risk patients who underwent DSAEK in a referral ophthalmological centre. These results can help us understand the limitations and risks of this surgery in this group of patients. We can conclude that adverse outcomes are highly common in high-risk patients who received a DSAEK, especially in those

patients for whom a graft previously failed or with a glaucoma drainage device. The most common complication was graft detachment, with a rate similar to other reports in non-high-risk patients. In our study, previous graft failure is a higher risk factor than a GDD. This nature of this study (retrospective) and the lack of comparison does not provide enough evidence to draw conclusions about the difference between high-risk and non-high-risk patients. Further investigations are needed to definitively establish the risk factors, similarities, and differences between high-risk and non-high-risk patients who underwent a DSAEK.

Declarations

Conflict of Interests: The current manuscript has never been published nor submitted for publication. The authors do not have any economic, proprietary, or financial interests to disclose in the publication of this paper.

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Synopsis/Precis: High risk DSAEKs were evaluated and adverse outcomes are very frequent, especially in those patients with a previous graft failure or a glaucoma drainage device. The most common complication was graft detachment in our patients.

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Figures

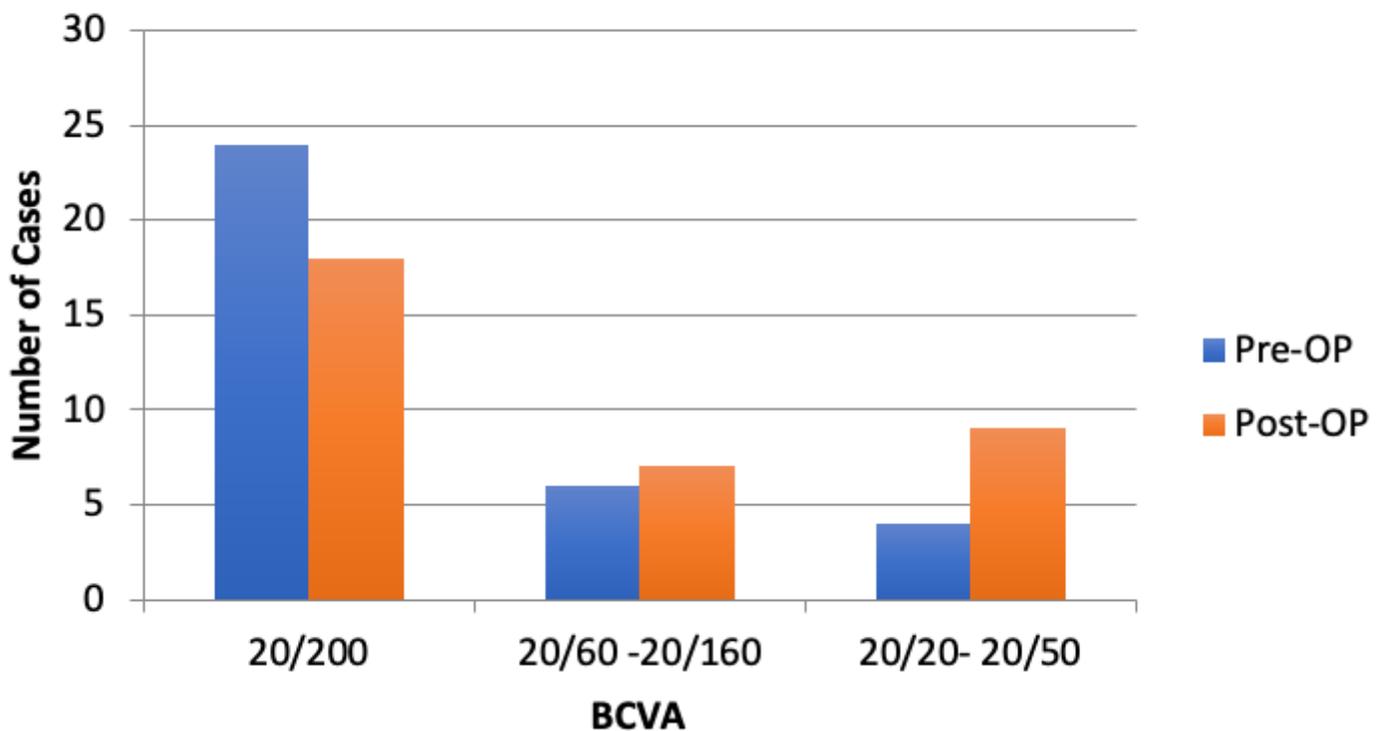


Figure 1

Preoperative vs postoperative BCVA

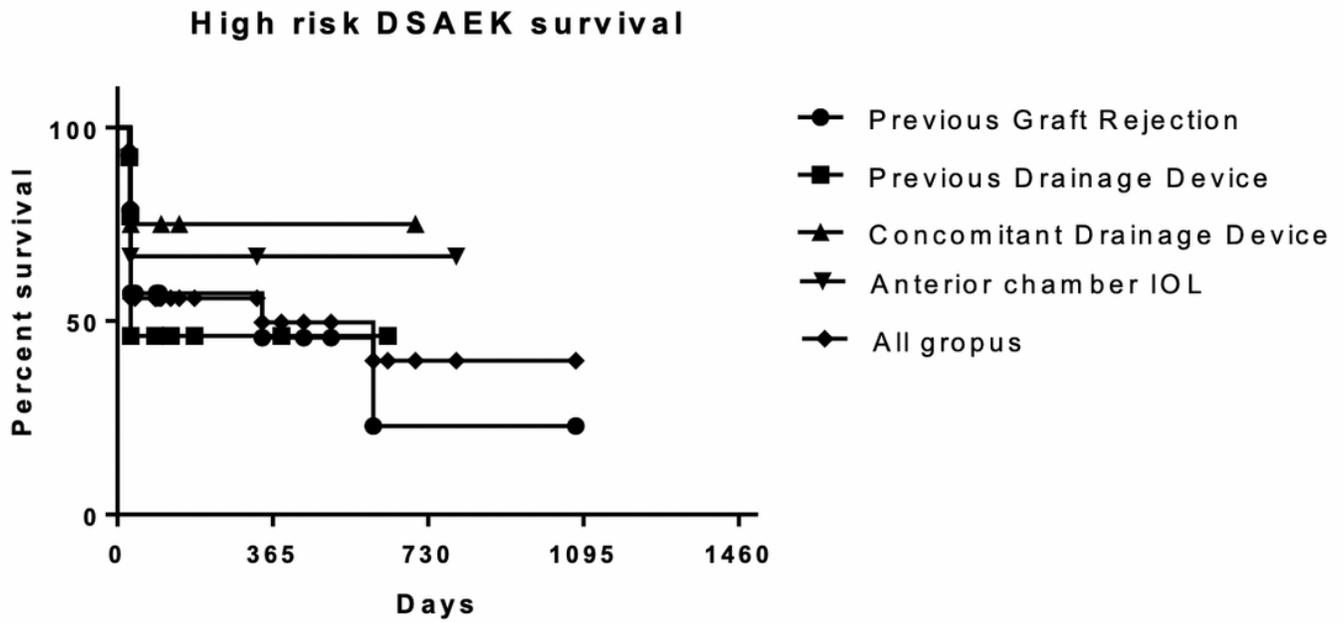


Figure 2

Kaplan Meier survival curves

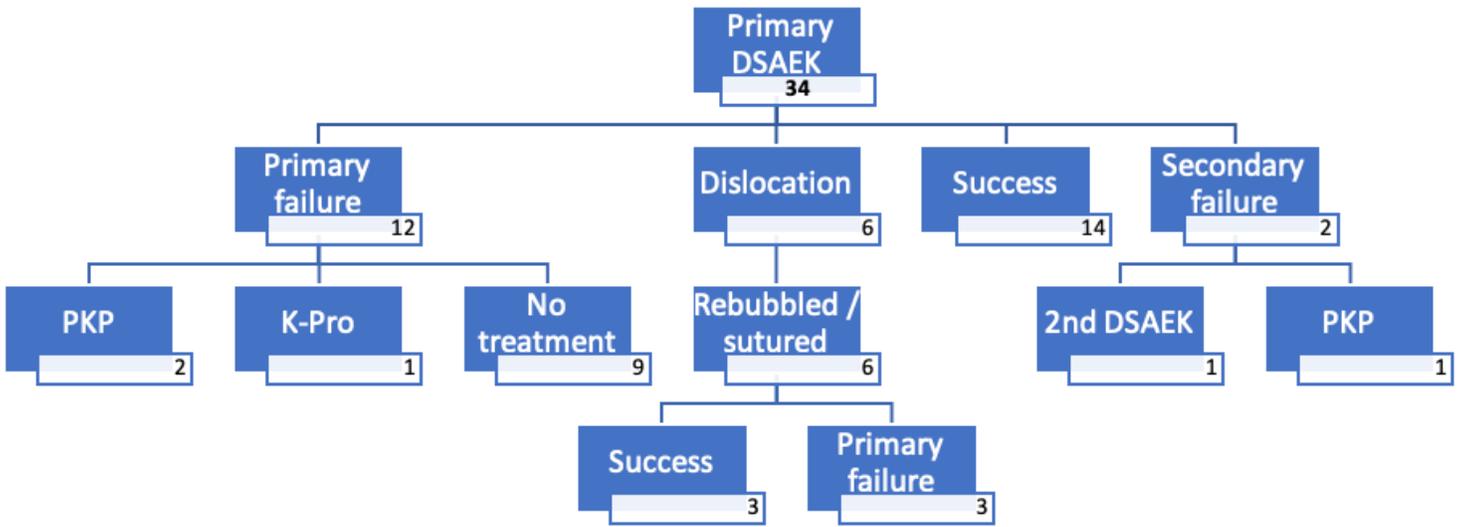


Figure 3

Flowchart of High risk DSAEK outcomes