ORIGINAL ARTICLE

Descemet stripping endothelial keratoplasty versus penetrating keratoplasty in bullous keratopathy: A 2-year analysis of graft survival and outcomes in a tertiary eye centre in Kuala Lumpur

Yong Zheng Wai, FRCOphth[1], Xu Kent Pee, MBBS[2], Yin Peng Lai, MS (Ophthal)[1], Rohanah Alias, MS (Ophthal)[1]

[1]Department of Ophthalmology, Kuala Lumpur Hospital, Kuala Lumpur, Malaysia, [2]Department of Ophthalmology, Sarawak General Hospital, Sarawak, Malaysia

ABSTRACT

Introduction: This study aims to compare the 2-year graft survival and outcomes of descemet stripping endothelial keratoplasty (DSEK) and penetrating keratoplasty (PK) for the treatment of bullous keratopathy (BK) among multiethnic Malaysia populations treated at a Tertiary Eye Centre in Kuala Lumpur, Malaysia.

Materials and Methods: This was a retrospective study of BK or Fuchs endothelial dystrophy (FED) patients who underwent DSEK or PK from 2015 to 2019 in Kuala Lumpur Hospital with a minimal post-operative follow-up of 2 years. Outcome measures included best-corrected visual acuity (BCVA), graft survival and complications. A total of 26 DSEK cases and 32 PK cases were included.

Results: At 2 years, graft survival rates were quite similar in two groups (DSEK 80.8% vs PK 75%, *p*=0.765). The mean follow-up period was 35.2 months in DSEK and 31.4 months for PK (*p*=0.465). The cumulative survival rates were slightly higher in the DSEK group (DSEK 73.1% vs PK 53.1%, *p*=0.119), but the result was not statistically significant. Post-operative complications were associated with higher graft failure in both groups (*p*=0.019). DSEK group has better post-operative BCVA (LogMAR DSEK 0.42 vs PK 0.83, *p*=0.003).

Conclusion: Similar graft survival rates were observed with both corneal transplant techniques for 2 years among Malaysian patients with BK. Post-operative complications can cause a higher risk of graft failure. DSEK produced better post-operative BCVA compared to PK.

KEYWORDS:
Bullous keratopathy; penetrating keratoplasty; descemet stripping endothelial keratoplasty

INTRODUCTION

Bullous keratopathy (BK) is characterised by corneal endothelial decompensation associated with irreversible corneal oedema. Aetiologies include Fuchs endothelial dystrophy (FED), iridocorneal endothelial syndrome (ICE), congenital hereditary endothelial dystrophy (CHED) and endothelial injury caused by intraocular surgeries such as phacoemulsification or glaucoma surgeries.

Descemet stripping endothelial keratoplasty (DSEK) and penetrating keratoplasty (PK) are safe surgical procedures to treat BK.[1] PK involved full-thickness corneal transplant, while DSEK only involved posterior stroma, Descemet membrane and endothelial of the cornea.

Complications of PK and DSEK include infection, wound dehiscence, and most importantly graft failure. Several risk factors are associated with a higher risk of graft failures, such as young patient, graft for corneal ulcer, large graft size, suture-related inflammation and ABO incompatibility.[2,3]

The most important outcome is the graft survival rate. Few articles have been published on this topic, especially in Western countries and Eastern Oriental countries (mostly the Chinese population).[4-7] Data on other ethnicities in South East Asia such as Malay, Indian and Natives population are not reported.

Even with all the reported results, there is no conclusive result and unified recommendation. United Kingdom National Transplant Registry reported a higher graft failure in the endothelial keratoplasty (EK) group than the PK group in FED at 2 years.[8] Similarly, Hong Kong researchers noticed DSEK has poorer survival in 2 years than the PK group. However, in Taiwan and Singapore, studies with predominantly Chinese patients reported better graft survival in the EK group than PK for BK at 100-days and 5 years, respectively.[5,7] Otherwise, a Cochrane review and a few studies from Western and Eastern countries with mostly Oriental patients have no statistical difference between the DSEK and PK groups in terms of graft survival.[9-11]

The present study aimed to report the graft survival and outcomes of both PK and DSEK in BK patients among multiethnic Malaysia populations treated in a tertiary referral center in Kuala Lumpur, Malaysia.

This article was accepted: 02 December 2022
Corresponding Author: Yong Zheng Wai
Email: yong_zheng92@hotmail.com

MATERIALS AND METHODS

This retrospective study was conducted in Kuala Lumpur Hospital, following the tenets of the Declaration of Helsinki and ethics approval obtained from our local institutional review board (Medical Research & Ethics Committee, Ministry of Health; NMRR ID-21-02147-JF6). BK patients who underwent corneal transplantation from 2015 to 2019 in Hospital Kuala Lumpur were included. Their identities were extracted from the corneal transplant logbook recorded in the Ophthalmology Department of Kuala Lumpur Hospital. All corneal transplantation surgeries were conducted by three corneal consultants and three fellows in Kuala Lumpur Hospital. All surgeries were using the standard surgical techniques of DSEK and PK. Most of the corneal grafts were imported from the United States with only a few of them being local donors. A minimum follow-up of 2 years post-operative is required to be included in this study. All patients were transplant-virgin. We excluded patients that underwent repeated corneal transplants

The basic demographic was extracted. Factors of interest include age, race, gender, diagnosis, laterality, corneal transplantation operation date, type of operation, donor source, graft size, pre-operative best-corrected visual acuity (BCVA), co-morbidities, ocular co-morbidities, post-operative BCVA, survival periods and complications.

Study outcome measures were compared between DSEK and PK groups. Graft survivability between both groups will be compared over a 2 years and cumulative period and look for any statistical significance. The definition of graft failure was based on the definition used in the collaborative corneal transplantation studies, which were an irreversible loss of optical clarity sufficient to compromise vision for a minimum of consecutive 3 months.[12]

Statistical Analysis

All the data analysis will be analysed by using the SPSS version 25. Descriptive data will be done to describe the demographic of the population. Categorical data will be expressed in frequency and percentage, numerical data will be expressed in terms of mean and standard deviation (if normally distributed), and median with interquartile range (if abnormally distributed). For inferential analysis, all the categorical data will be analysed with chi-square test while numerical data will be analysed with Independent t-test. Mann–Whitney U tests were used for the skewed data. Fisher-exact test was used if the criteria for chi-square test were not met. Kaplan–Meier survival curve will be conducted to determine the 2-year and cumulative survival probabilities of DSEK and PK groups. Cox regression was used to assess the association between any factors and graft failure. A p value <0.05 will be considered statistically significant.

RESULTS

Among a total of 58 patients (33 males and 25 females) with BK, 32 cases of PK and 26 DSEK operations were done in a multiethnic Malaysia population in Kuala Lumpur Hospital. Basic demographic and surgical outcomes of patients who underwent PK or DSEK procedures were summarised in Table I.

Totally eight patients underwent combined surgery. Most of the combined surgery were triple procedure (62.5%). PK group has a higher proportion of combined surgery; however, there was no statistical difference between two groups.

Graft survival at 2 years in DSEK was 80.8% vs 75.0% in PK (p=0.765). Cummulative graft survival showed no statistic difference between DSEK and PK (DSEK 73.1% vs PK 53.1%, p=0.119) (Figures 1 and 2).

Cox analysis revealed that ethnicity, gender, age, graft size, ocular co-morbidities, combined surgery and presence of glaucoma drainage devices showed no significant effects on the graft survival rates. Eyes with post-operative complications were more likely to fail compared with eyes without complication (HR, 5.47; 95% CI, 1.44-60.71; p=0.019).

DISCUSSION

There are only limited articles provide result of DSEK vs PK in a South-East Asian populations. Most of the reported data are mainly from Western countries (Caucasian) and East Asian (Chinese & Korean).[4-6] Singapore who had quite a similar population with Malaysia conducted similar study reported 76.6% of their patients are Chinese.[7] To our best knowledge, there is no article comparing the outcome of DSEK and PK among BK patients in a balanced multiethnic South-East Asian population. Our study comprised 39.6% of Malay ethnicity, 10.3% Indian and 5.2% of natives originating from Sabah or Sarawak (Borneo island).

It has been a long debate on whether DSEK or PK will have a greater graft survival rate in BK or FED patients. Data from different regions of the world showed a different result. Most of the studies have no statistical difference between DSEK and PK. Singapore reported DSEK has a superior graft survival rates compared to PK.[7] Taiwan and UK studies revealed a higher graft survival rate in PK groups.[5,8]

Our 2-year survival for DSEK and PK is 80.8% and 75%, respectively, with DSEK marginally survived longer than PK. Our DSEK survival rate is comparable with other studies at 2 years periods (70–81% in UK and 81% in Hong Kong).[2,4] In contrast, our PK survival rate is relatively lower compared to UK (79–94%) and Hong Kong (88%) at 2 years period.[2,4] The lower PK graft survival rate in this study was similar to the finding from Korea and Singapore, and this has contributed to the difference in our result from the UK and Hong Kong.[2,4,6,7] However, the difference is not statistically significant in our population.

Cumulative graft survival analysis showed a further discrepancy between DSEK and PK graft survival (73.1% vs 53.1%). Our mean follow-up periods for both groups were around 31.4 and 35.2 months. Even though our follow-up period was not up to 5 years, our cumulative result resembles two Singapore 5-year studies.[7,13] In the South-East Asian population, DSEK graft survived better than PK albeit our result is not statistically significant. Similarly, our PK survival rate was poorer than UK and Dutch registry study.[2,14]

Table I: Data comparison between DSEK and PK groups (n=?)

	DSEK	PK	*p* value
No of cases (n)	26	32	
Age (year)	68.8	60.7	0.081#
Gender:			0.136
Male (n, %)	12, (46)	21, (66)	
Female (n, %)	14, (54)	11, (34)	
Ethnicity:			0.380
Malay (n, %)	8, (31)	15, (47)	
Chinese (n, %)	15, (58)	11, (34)	
Indian (n, %)	2, (8)	4, (13)	
Others (n, %)	1, (3)	2, (6)	
Mean follow-up period (months)	35.2	31.4	0.465
Pre-operative BCVA (LogMAR)	1.49	1.77	0.051
Ocular co-morbidities (n, %)	10 (38)	18 (56)	0.178
Operation duration (minutes)	83.6	83.8	0.981
Combined surgery (%)	3.8	21.9	0.063*
Post-operative complication rate (%)	11.5	31.3	0.073
Post-operative BVCA (LogMAR)	0.42	0.83	0.002#
Graft survival at 2 years (%)	80.8	75.0	0.765
Cumulative graft survival (%)	73.1	53.1	0.119

*Fisher-exact test was used.
#Mann–Whitney test was used.
best-corrected visual acuity (BCVA),
LogMAR: Logarithm of the Minimum Angle of Resolution

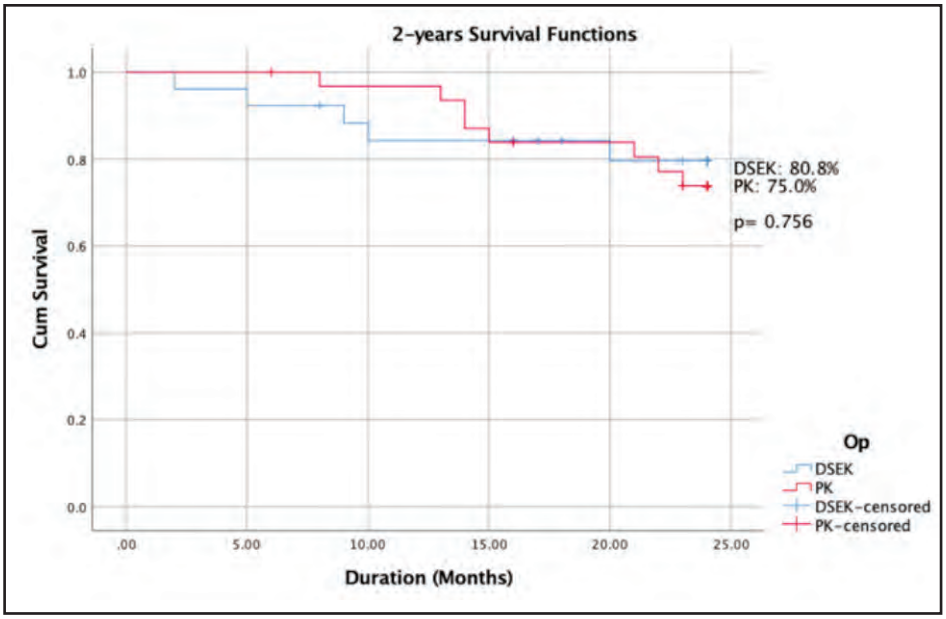

Fig. 1: 2-years survival analysis between DSEK and PK using Kaplan–Meier graft survival curve

In this study, the pre-operative BCVA results were similar for both PK and DSEK groups. Post-operative BCVA was significantly better in the DSEK group (p=0.002), this result was consistent with other studies.[2,6] DSEK has a better advantage in terms of refraction stability and shorter visual rehabilitation compared to PK.

Cox analysis of graft failure, we noticed eyes with complications had higher graft failure with a hazard ratio of 5.47. The most common complication from our study was raised intraocular pressure and glaucoma. Topical pressure-lowering medications are known risk factors for graft failure.[15] It has been reported that topical glaucoma medications can increase leukocyte and fibroblast accumulation in conjunctival and limbal tissue.[16] These pro-inflammatory cells could trigger immunologic recognition of donor tissue leading to graft rejection and failure if did not treat promptly.[15]

Other complications included infective keratitis. Two of our patients experienced infective keratitis (bacterial keratitis and HZO keratitis) after PK and DSEK procedure. Graft infection is a bane for all corneal surgeons and likely will lead to graft failure.[17] Despite given medical therapy, both of the grafts failed and the visual outcome were very poor. Vajaypee et al.[18] reported visual prognosis in eyes with post-keratoplasty graft infection is guarded despite optimal therapy.

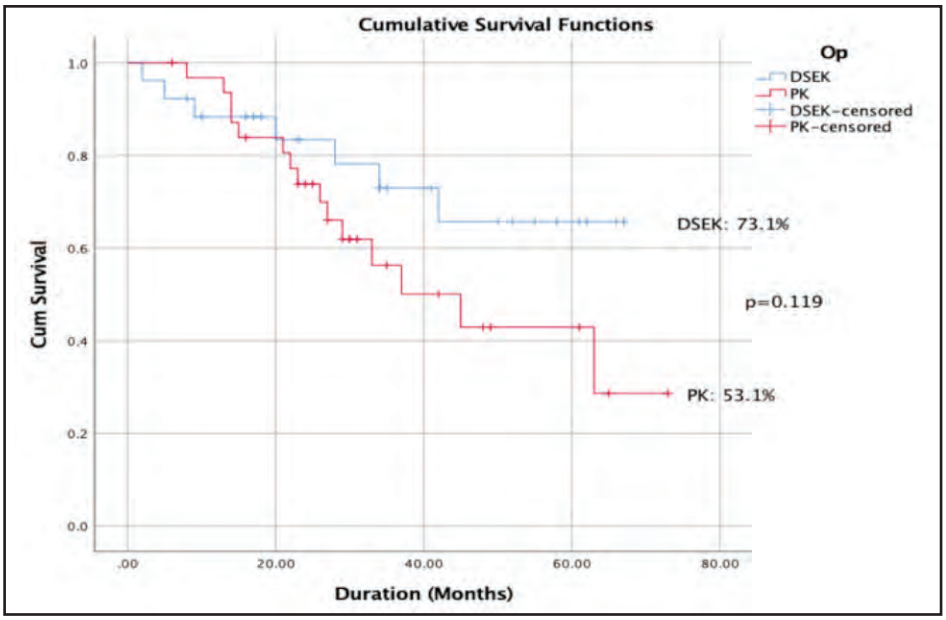

Fig. 2: Cumulative Kaplan–Meier graft survival curve comparing overall DSEK and PK in the overall study period

There are few limitations in this study, which include the small sample size and relatively short follow-up. Ideally, 5 years or longer follow-up and a larger sample will yield more valuable data. Besides that, we were not able to perform endothelial cell count measurement due to the limitation of our resources. This study provides post-keratoplasty outcomes in a multiethnic South-East Asian population from Kuala Lumpur, Malaysia.

CONCLUSION

In conclusion, DSEK and PK have similar graft survival rates for 2 years among Malaysian patients with BK. Eye which underwent DSEK had significantly better post-operative BCVA compared to PK. Future studies comparing long-term survival and outcomes of DSEK and PK will undoubtedly further our knowledge of each technique's advantages.

ACKNOWLEDGEMENTS

The authors would like to thank the Director-General of Health Malaysia for his kind permission to publish this article. This study does not receive any form of funding.

REFERENCES

1. Lee WB, Jacobs DS, Musch DC, Kaufman SC, Reinhart WJ, Shtein RM. Descemet's stripping endothelial keratoplasty: safety and outcomes. A report by the American Academy of Ophthalmology. Ophthalmology 2009; 116(9): 1818-30.
2. Keane MC, Galettis RA, Mills RAD, Coster DJ, Williams KA. A comparison of endothelial and penetrating keratoplasty outcomes following failed penetrating keratoplasty: A registry study. Br J Ophthalmol 2016; 100(11): 1569-75.
3. Sellami D, Abid S, Bouaouaja G, Ben Amor S, Kammoun B, Masmoudi M, et al. Epidemiology and risk factors for corneal graft rejection. Transplant Proc 2007; 39(8): 2609-11.
4. Wah LAL, Wai KRP, Kam KW, Young AL. A 5-year analysis of endothelial vs penetrating keratoplasty graft survival in Chinese patients. Int J Ophthalmol 2020; 13(9): 1374-7.
5. Hsiao FC, Chen PY, Meir YJJ, Tan HY, Hsiao CH, Lin HC, et al. Clinical outcomes of penetrating keratoplasty and descemet stripping automated endothelial keratoplasty in asian population with American corneas. Int J Environ Res Public Health 2019; 16(22): 1-12.
6. Kim SE, Lim SA, Byun YS, Joo CK. Comparison of long-term clinical outcomes between descemet's stripping automated endothelial keratoplasty and penetrating keratoplasty in patients with bullous keratopathy. Korean J Ophthalmol 2016; 30(6): 443-50.
7. Ang M, Soh Y, Htoon HM, Mehta JS, Tan D. Five-year graft survival comparing descemet stripping automated endothelial keratoplasty and penetrating keratoplasty. Ophthalmology 2016; 123(8): 1646–52.
8. Greenrod EB, Jones MNA, Kaye S, Larkin DFP. Center and surgeon effect on outcomes of endothelial keratoplasty versus penetrating keratoplasty in the United Kingdom. Am J Ophthalmol 2014; 158(5): 957-66.e1.
9. Nanavaty MA, Wang X, Shortt AJ. Endothelial keratoplasty versus penetrating keratoplasty for Fuchs endothelial dystrophy CONTRIBUTIONS OF AUTHORS Conceiving the review: MN, AS Designing the review: MN, AS Coordinating the review: MN Data collection for review Designing electronic. 2014; Available from: www.controlled-trials.com
10. Nam KY, Lee JE, Lee JE, Jeung WJ, Park JM, Park JM, et al. Clinical features of infectious endophthalmitis in South Korea: a five-year multicenter study. BMC Infect Dis 2015; 15: 177. Available from: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=4399575&tool=pmcentrez&rendertype=abstract
11. Anshu A, Price MO, Price FW. Risk of corneal transplant rejection significantly reduced with Descemet's membrane endothelial keratoplasty. Ophthalmology 2012; 119(3): 536-40.
12. The collaborative corneal transplantation studies (CCTS). Effectiveness of histocompatibility matching in high-risk corneal transplantation. The Collaborative Corneal Transplantation Studies Research Group. Arch Ophthalmol 1992; 110(10): 1392-403.

13. Woo JH, Ang M, Htoon HM, Tan D. Descemet membrane endothelial keratoplasty versus descemet stripping automated endothelial keratoplasty and penetrating keratoplasty. Am J Ophthalmol 2019; 207: 288-303.
14. Dickman MM, Peeters JMPWU, van den Biggelaar FJHM, Ambergen TAW, van Dongen MCJM, Kruit PJ, et al. Changing practice patterns and long-term outcomes of endothelial versus penetrating keratoplasty: a Prospective Dutch Registry Study. Am J Ophthalmol 2016; 170: 133-42.
15. Price MO, Thompson RW, Price FW. Risk factors for various causes of failure in initial corneal grafts. Arch Ophthalmol 2003; 121(8): 1087-92.
16. Sherwood MB, Grierson I, Millar L, Hitchings RA. Long-term morphologic effects of antiglaucoma drugs on the conjunctiva and Tenon's capsule in glaucomatous patients. Ophthalmology 1989; 96(3): 327-35.
17. Varley GA, Meisler DM. Complications of penetrating keratoplasty: graft infections. Refract Corneal Surg 1991; 7(1): 62-6.
18. Vajpayee RB, Sharma N, Sinha R, Agarwal T, Singhvi A. Infectious keratitis following keratoplasty. Surv Ophthalmol 2007; 52(1): 1-12.