Transportation of Preloaded DMEK Grafts

To the Editor:

Referring to the study of Catala et al, which revealed comparable endothelial cell loss and phenotypical marker expression of prestripped Descemet membrane endothelial keratoplasty (DMEK) grafts shipped in conventional flasks or the RAPID transport cartridge (Geuder AG; Heidelberg, Germany),[1] we support these findings by clarifying the effect of transport temperature on tissue quality (endothelial cell count [ECC] and vitality of endothelial cells) of the corneal grafts in the RAPID transport cartridge.

The use of ready-to-use grafts from specialized eye banks could have enormous advantages, such as the controlled quality of the grafts, the guaranteed availability at a certain operation time, and a reduced surgical complexity of the DMEK surgery.[2] However, it is essential that the delicate lamellae are not affected by this processing and transport conditions. This has now been investigated in various protocols suggesting suitability for clinical use.[1–5]

As Catala et al performed the shipping of the DMEK grafts at ambient temperature, it is not unlikely that temperature will fluctuate and potentially affect the tissue. We therefore investigated whether the transport temperature of preloaded grafts in the RAPID transport cartridge (Geuder AG; Heidelberg, Germany) has an influence on the ECC and cell viability.

Three pairs of corneas (n = 6) were examined, which were unsuitable for transplantation and had written consent from the donor's next of kin to be used for research purposes. The central ECC was determined after deswelling with the Robin Endothelial Analyzer (REA, Robin Solutions, Wuppertal, Germany) by taking 3 images of different locations in the optical zone (measurement 1). All DMEK graft preparations were performed by an experienced eye bank technician using the liquid bubble technique, as recently described,[6] and then stored for 3 days in a medium containing dextran [KM2, medium based on minimal essential medium, 6% Dextran 500T, Pen/Strep, 2.4% FCS (F9017, Merck Millipore, Germany)] at 32°C. Afterward, the ECC was determined again (measurement 2). All lamellar grafts were detached from the stroma and preloaded into the RAPID transport cartridge, transferred to the appropriate transport holder and placed in a culture bottle filled with KM2. After the simulated transport, the final determination of ECC was performed after 48 hours, after the preloaded lamellae were injected, similar to the DMEK surgery, and spread in a KM2-filled well plate (measurement 3). The viability of the corneal endothelial cells was determined by taking 3 images of different locations in the optical zone with a Live/Dead cell assay by Calcein-AM staining (MP03224, Thermo Fisher Scientific, Waltham, MA). For statistical analysis, we used R (v. 3.6.3). All results are presented as arithmetic mean and ±SD. A P value of <0.05 was defined as statistically significant.

The evaluation of the central ECC measurement showed that neither the processing itself nor the transport at 10°C or 37°C had a negative influence on the quality of the corneas [group 10°C: measurement 1 2363 ± 127 cells/mm^2, measurement 2 2376 ± 123 cells/mm^2, and measurement 3 2370 ± 113 cells/mm^2 ($P = 0.99$) versus group 37°C: measurement 1 2363 ± 89 cells/mm^2, measurement 2 2373 ± 128 cells/mm^2, and measurement 3 2376 ± 117 cells/mm^2 ($P = 0.98$) (analysis of variance), respectively]. The Live/Dead Assay also showed that the 2 different transport temperatures had no negative influence on the viability of the endothelial cells.

Therefore, it could be shown that neither the selected minimum transport temperature of 10°C nor the selected maximum transport temperature of 37°C had a negative influence on the quality (ECC and viability of endothelial cells) of the corneal grafts in the RAPID transport cartridge. These results are in concordance with the findings of Catala et al[1] who performed the transport at ambient temperature. Further examinations on different media and the influence on the metabolism of the cells, or its long-term effect if used for transplantation, should follow.

In conclusion, our results are an additional indication that the RAPID transport cartridge could be used under organ culture medium conditions with transport temperatures of 10°C and 37°C without negative influence on preloaded grafts with regard to central ECC and cell viability.

Financial disclosures/conflicts of interest: P. Szurman has a patent for a device for preparing and introducing a transplant or an implant into a living body, particularly for ophthalmological interventions: EP2533724 B1; WO2012065602 A3. P. Szurman has a pendant patent for the transport cartridge: EP 3 046 509 A1. All other authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements) or nonfinancial interest (such as personal or professional relationships, affiliations, knowledge, or beliefs) in the subject matter or materials discussed in this manuscript.

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