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Nanofiber membrane cell delivery system

Current challenges in corneal endothelial cells (CEC) transplantation include the limited availability of donor grafts and the inability of CECs to regenerate within the body. Procedures like Descemet's Membrane Endothelial Keratoplasty (DMEK) offer good visual outcomes but are complex and have higher rates of post-operative complications. Moreover, direct cell injection approaches are still undergoing clinical trials and are not widely available.

To address the above need, Stanford researchers have created a biodegradable, transparent nanofiber membrane through electrospinning, using biopolymers like collagen and gelatin. These membranes are highly permeable, mechanically tunable, and can be cross-linked with glycosaminoglycans to support cell growth and attachment. By serving as a transient scaffold for cell delivery, this solution offers a minimally immunogenic method for CEC transplantation, addressing the need for more accessible, effective corneal repair techniques.

Stage of Development
In vivo animal models: After confirming protein expression via the transplantation of human and rabbit CECs onto the fabricated gel nanofiber membrane, ex vivo tests were conducted to validate the transplantation of cells into freshly harvested rabbit corneas.

Applications

- Carrier for corneal cell transplantation
- Nanofibre membrane patch for cornea regeneration
- Nanofiber membrane for ocular drug delivery

Advantages

- Adjustable mechanical property and thickness
- High permeability of biological factors
- Transparency in visible light wavelength
- Biocompatible and biodegradable
- Significantly reduced waiting time for cell attachment (5 min for nanofiber membrane and 15min for spraying system)

Publications

- Song, E., Chen, K. M., et al. (2024). Electrospun Nanofiber Membrane for Cultured Corneal Endothelial Cell Transplantation. Bioengineering, 11(1), 54.

Patents

- Published Application: WO2025137557

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