2024 Multidisciplinary Research Program in Medicine Project*: Development of novel hybrid co-polymer for corneal stromal tissue engineering*

Hypothesis or Research Question(s): A bio-engineered hybrid co-polymer of HA and cellulose can be successfully implanted as a human corneal stroma substitute to restore vision in Corneal blindness patinets

PROJECT BACKGROUND & SUMMARY

Over 30 million people in the world are blind in one or both eyes from corneal injury or disease. Approximately 2 million new cases of corneal blindness are reported each year. Corneal transplantation (keratoplasty) is often the only mean of visual rehabilitation from corneal opacification. A recent study assessed the shortage of corneas at one available for 70 needed. As most corneal diseases affect the corneal stroma (mid-layer), selective stromal keratoplasty can be performed. Given the mentioned scarcity of donor tissue, there is a need to develop artificial or bio-engineered corneal stromal substitutes. To date, only collagen based-compounds have been utilised in vivo for stromal replacement, with very preliminary/unsatisfactory results. An ideal substitute of corneal stroma should be a mouldable, strong, biocompatible, transparent, suturable, metal-free compound that would also allow cell adhesion and proliferation and prevent vascularization. In the pilot phase, we created a novel hybrid copolymer composed of cellulose and hyaluronic acid (HA) and optimized the composition in terms of optical, chemical and mechanical properties to combine synergistically the bioactive features of HA and the mechanical properties cellulose. We aim to further test the optimized hydrogel and test its biocompatibility in vitro and in an animal model.

More specifically, the following specific aims are defined for this study:

1. To create an optimal shape of the hydrogel and assess ultrastructure and suturability
2. To test corneal epithelial cells adhesion, proliferation and viability on to the hydrogel surface
3. To test biocompatibility and long term survival in an animal model

BENEFIT TO THE STUDENTS

We are looking for a motivated undergraduate student to work on basic science experiments involving the use of natural polymers and hydrogel for bioengineering of the eye. The applicant will be conducting a variety of experiments which would include preparation of the hydrogels, testing biocompatibility of the hydrogel and characterization of cell phenotype and function in relation to the hydrogel. The work will take place at Dr Foster's lab at the Department of Chemical and Biological Engineering , UBC. Full time commitment is required for the duration of the job. The applicant will be primarily responsible for the experiments, data collection and will be mentored by senior scientists, physicians, postdoctorate associates and graduate students and trained on pertinent basic science techniques. Scientific publication of the results and presentation at national or international meeting will also be expected. We recognize the importance of equity, diversity, and inclusion (EDI) in the research team. As a woman with lived experiences of being a minority, the PI has a strong commitment to learning about EDI, the experiences of marginalized communities, and frameworks of inclusion. As a result, she actively participates in EDI events and continues to train the next generation of engineers to respect, apply and embed EDI in their work. The team will continue to actively recruit and engage underrepresented groups with the help of UBC resources such as the Equity & Inclusion office, Indigenous Research Support Initiative and the Applied Science Associate Dean for Equity & Inclusion