5 September 2023

2023-2024 Hector Maclean Scholarship Projects

Project One: Resolving corneal scarring with a novel factor

Supervision: Prof Mark Daniell and Dr Gink Yang

Research Group: Corneal Research

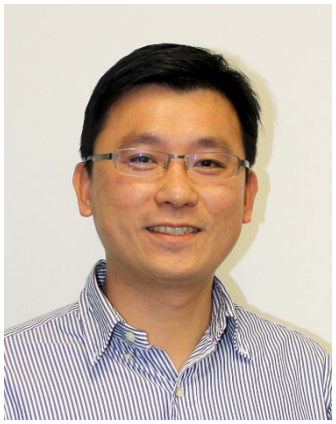
Project summary:

Blindness due to corneal scarring is an unaddressed challenge affecting 10 million people worldwide. Corneal scarring remains a distressing issue for Australian indigenous communities, especially in children and the elderly with trichiasis. The prolonged use of current clinical treatments such as corticosteroids delays wound healing and may contribute to poor visual outcomes resulting from endothelial cell loss or secondary glaucoma. Worldwide, corneal scarring remains a major complication following glaucoma filtration surgery, corneal refractive surgery, and corneal infections such as herpetic stromal keratitis. Focusing on the key mechanisms of corneal scarring, we have identified an anti-scarring factor that is shown to limit scarring following fibrosis induction in human corneal cells. The current project aims to further validate the efficacy of the factor *in vitro.*

Selection Criteria:

Biotechnology or Biomedical science students who are interested in drug development and validation. The successful applicant will need laboratory experience in molecular biology and tissue culture; and be able to work independently.

Project Two: Goodbye, needles! an on-demand gene therapy for neovascular blindness to avoid frequent eye injections



Supervised by: A/Prof Guei-Sheung Liu

Research Group: Genetic Engineering Research Unit

Project Summary: Excessive growth of blood vessels in the eye causes loss of vision and can only be treated with painful and frequent injections of medicine into the eye, which might be dangerous in the long-term. The project aims to advance in gene therapy that can be initiated by eye drops to provide a safer and less invasive alternative to conventional drug injections. Such a novel approach in health practices could revolutionise ophthalmic care by making treatment by needles obsolete.

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We encourage students with backgrounds in biomedical science, molecular biology, genetics, biochemistry, and optometry and visual science to apply for this opportunity. Experiences in the laboratory with molecular biology and tissue culture would be advantageous, but it is not mandatory.

Project Three: In vivo imaging analysis of retinal gene therapy outcomes

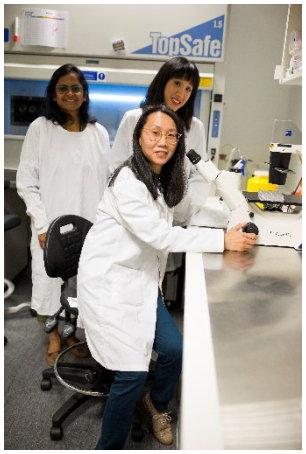
Supervisor: Dr Carla Abbott

Research Group: Macular and bionics

Project Summary: Retinal gene therapy for inherited retinal disease is currently a hot topic of ophthalmology research. Most retinal gene therapy currently in clinical use requires an injection under the retina (subretinal) to get the viral vector to the location it is needed close to the photoreceptor layer. However, this requires an operating theatre and a subspecialty ophthalmologist. Retinal gene therapy for photoreceptor diseases would become quicker, cheaper and more readily accessible if an injection directly inside the eye (intravitreal) was used instead. However, currently, the penetration (transvection) of the vector to the photoreceptor layer from an intravitreal injection is not often efficacious enough. This project is looking at ways to improve the intravitreal injection approach to gene therapy using electrical stimulation in a preclinical model. The in vivo retinal imaging data has been collected, and the student will help process and analyse the images. They will learn skills relating to optical coherence tomography imaging, confocal laser scanning ophthalmoscopy, retinal image export and analysis including statistics. No specific prior knowledge is required.

Timeline: This is a 4-week project to be conducted in November – December 2023.

Project Four: Preventing Glaucoma Blindness Through a Novel Approach to Antifibrosis



Supervisors: Dr Elsa Chan and Dr Jennifer Fan Gaskin

Research Group: Ocular Fibrosis Unit

Project Summary: Glaucoma is the commonest cause of irreversible blindness in the world. Treatment for glaucoma targets the lowering of intraocular pressure and can be delivered through medical therapy, laser treatment or surgery. Glaucoma filtration surgery is effective and cost- effective. However, scarring limits its long-term effectiveness. Currently postoperative scarring is addressed through non-specific cancer drugs such as Mitomycin C and 5-Fluorouracil, but these drugs have considerable side-effects and scarring can still be problematic. In recent years, a plethora of new, minimally- invasive glaucoma surgical devices have been introduced to the market as an alternative option to glaucoma filtration surgery. These devices have been popular, however, it is already becoming apparent that postoperative scarring is limiting the role of these devices in the long-term management of glaucoma. Our research unit focuses on developing new anti-scarring agents for glaucoma surgery and other eye diseases. The projects are predominantly preclinical (animal and *in vitro* cell cultures) but very much with a translational perspective. Students would have the opportunity to learn and develop and number of techniques including cell culture and histology.

Project Five: Good cholesterol for treatment of age-related macular degeneration

Supervisors: Dr. Manisha H Shah, Dr. Carla Abbott, Prof. Robyn Guymer

Research group: Macular Research



Project Summary: Age-related macular degeneration (AMD) is a disease of the macula and is a leading cause of blindness. The accumulation of lipid-rich cholesterol (bad cholesterol) underneath the retina is a hallmark sign of AMD. However, high density lipoproteins (HDL or good cholesterol) have known anti-oxidative, anti-inflammatory and pro-cholesterol efflux properties. Furthermore, our preliminary observations show that patients with AMD have a higher level of dysfunctional HDL than age-matched control patients. Hence, we hypothesise that HDL functionality has a role in the development and progression of AMD. This project will investigate the composition and functionality of HDLs derived from AMD patients and age-matched healthy controls. The participant samples have been collected and are ready for laboratory experiments to be conducted. The student will be trained on performing molecular and cell culture-based experiments, ELISA based assays, microscopy techniques and data analysis in a laboratory setting. No specific prior knowledge is required, but the student must have a desire to work in the laboratory setting.

Timeline: This is a 4-6 week project to be conducted in November - December 2023