LABORATORY PROJECTS

Please note these projects are aimed for honours, vacation scholarship and volunteer students. For more information or PhD projects, please contact Dr Lisa Nivison-Smith (l.nivison-smith@unsw.edu.au)

WHY DOES THE VISUAL SYSTEM BECOME DYSFUNCTIONAL WITH AGE?

It is well-established that the visual system becomes dysfunctional with age. This process was assumed to be due to the is death of retinal cells with age. However, studies show there is actually a very poor relationship between cell death and age-related dysfunction. Thus the fundamental mechanisms that underlie age-related dysfunction are poorly understood.

This project investigates the role of neurochemistry are a mechanism behind age related visual loss. Abnormal glutamate signalling contributes to aging of other tissues but has not been explored in the retina. This project will use methodology such as electroretinography (ERG) and immunohistochemistry to measures age-related changes in glutamate uptake, transport and receptors in the retina.

IS VINPOCETINE A TREATMENT FOR RETINAL ISCHAEMIA?

Retinal ischaemia is the primary pathological process underlying several major retinal diseases including diabetic retinopathy, acute angle closure glaucoma and vascular occlusion syndrome. As there is still no effective treatment against irreversible cell death secondary to retinal ischaemia, there is a pressing need to understand retinal ischaemia and develop viable therapeutic strategies.

We recently demonstrated that vinpocetine, a natural herbal supplement, can improve retinal function after ischaemia. Vinpocetine increases glucose availability and regulates glutamtergic signalling in the retina suggesting it may be a potential treatment for ischaemia. This project investigates the mechanisms of action of vinpocetine in ischaemia and it potential as a preventive treatment for ischaemia using immunohistochemistry and metabolic assays.

WHAT IS THE ROLE OF RETINAL REMODELLING IN EARLY RETINAL DISEASE?

In many retinal diseases, photoreceptor cells dies leading to visual impairment and blindness. However, before cell death, other changes occur in the retina: cells sprout new processes and retract old ones, cells migrate to different retinal layers and the neurochemical signalling between cells is altered. These processes, called retinal remodelling occurs in early disease and therefore offer a new timepoint to treat retinal disease. They also offer windows to the underlying pathophysiology of retinal disease.

This project investigates retinal remodelling in animal models for retinal disease. These animals have mutations leading to blindness with mimic Retinitis Pigmentosa in humans. This project will investigate retinal remodelling using the agmatine tracking assay, immunohistochemistry and microscopy.
CLINICAL PROJECTS

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WHAT DOES THE NORMAL RETINAL LOOK LIKE ON ADVANCED IMAGING?

In the past 10 years, there has been an explosion of new technologies to image the anterior and posterior eye. Whilst some of these modalities come with normative databases for comparison, these databases are small and commonly skewed in terms of age or ethnicity of the subjects. This is problematic as the database may flag normal patients as having disease or worse, miss patients with disease.

This project aims to generate a large normative database for multiple imaging modalities using the large patient cohort at Centre For Eye Health. Using the latest Spectralis software, this project will extract values for thickness of different retinal areas to create a comprehensive, usable database.

WHAT IS THE ROLE OF THE PERIPHERAL RETINA IN MACULA DISEASE?

Retinal diseases which involve the macula have devastating effects on patient’s vision. However, there is evidence than many of these diseases extend beyond the macular and affect other parts of the retina. This project investigates the role of the peripheral retina in macula diseases and the implications of changes in the peripheral retina in terms of disease detection and diagnosis. This project will involve analysing clinical images of the retina taken with advanced imaging modalities such as Optomap and optical coherence tomography (OCT) of patients with macula disease to characterise peripheral findings and the effect of incidental findings.

HOW DO DRUSEN AFFECT THE RETINA THROUGHOUT AMD

Age related macular degeneration (AMD) is a leading cause of blindness worldwide. Detection and diagnosis of AMD relies on imaging of early structural abnormalities known as drusen. Our group recently found that drusen alters the thickness of the retina directly above and in surrounding drusen-free areas. We have also found different drusen types have effects on different retinal layers.

This project expands on these findings, determining how these drusen related changes link to disease pathogenesis. This project using clinical images from AMD patient to measure changes relating to drusen using automated segmentation software and image analysis tools.

IMPROVING FUNCTIONAL TESTS FOR MAJOR RETINAL DISEASES

Although there have been significant advances in the development of new technologies to image the posterior eye, advances in testing the function of the visual system is lagging behind. This is problematic as our group has found the addition of new imaging modalities does not improve the diagnostic accuracy of complex eye diseases such as glaucoma. Thus maybe improving functional technologies rather than imaging technologies may improve eye disease detection and diagnosis. This project investigates new protocols for testing visual acuity and visual fields which improve the tests’ diagnostic utility and can be translated into clinical use.