Research Groups

Experimental Immunology

1. Viruses and Autoimmune Disease in the Eye
2. Tracking the fate of an inhaled virus
3. Natural Killer cell and cytomegalovirus interaction

Outback Medicine

4. Monitoring and evaluating teleophthalmology in Western Australia.
5. Monitoring and evaluating a culturally-appropriate teleophthalmology service in Western Australia.

Ocular Tissue Engineering

6. Induction of Pluripotency in Limbal Stem Cells
Lions Eye Institute Honours Projects 2015

**Project type — Suitable for Honours, Masters or PhD studies**

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<th>Supervisor(s)</th>
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**Details of project — Viruses and Autoimmune Disease in the Eye**

The phenomenon of immune privilege is believed to protect the eye from autoimmunity by sequestering auto-antigens and preventing local immune activation. However, experimental models of autoimmune uveitis clearly demonstrate that autoimmunity can be readily induced by systemic immunisation. In our recent experiments, we have demonstrated that infection with cytomegalovirus, a common human pathogen, is also able to induce autoimmune uveitis. Our next step is to learn more about how a common viral infection is able to induce autoimmunity in the eye.

This project will take advantage of our experience with mouse cytomegalovirus and ocular immunology. Laboratory work will entail engineering recombinant mouse cytomegalovirus, characterising the pathogenesis of infection in mice, and live imaging of the retina to assess the development of autoimmunity.

**Project references**

Research interests
Professor Mariapia Degli-Esposti’s group central focus is to determine the key cellular and molecular interactions that occur in response to viral infection. In recent years this research has provided important contributions to understanding how the immune system responds to infection and how, in turn, pathogens manipulate host immunity to improve their chances of survival. Mouse cytomegalovirus (MCMV) is used as a model virus infection, due to its similarity in structure and biology with the human cytomegalovirus (HCMV).

Research theme
- Infectious diseases/autoimmunity

Scientific discipline
- Immunology

Keywords
Eye, virus, ocular immune response, autoimmune uveitis

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**Details of project — Tracking the fate of an inhaled virus**

Cytomegalovirus is a common human pathogen. Infection is normally asymptomatic though the virus can produce severe disease in immunocompromised individuals such as the newborn and patients undergoing bone marrow or organ transplantation. Murine cytomegalovirus has been used widely to study acute and chronic infection, however most experimental models employ unnatural routes of infection.

This project will take advantage of our experience with mouse cytomegalovirus and immunology to track the fate of fluorescent cytomegalovirus after inhalation. Laboratory work will entail characterising the pathogenesis of infection in mice, fluorescent imaging of infected organs, and flow cytometry.

**Project references**


Lions Eye Institute Honours Projects 2015

Research interests
Professor Mariapia Degli-Esposti’s group central focus is to determine the key cellular and molecular interactions that occur in response to viral infection. In recent years this research has provided important contributions to understanding how the immune system responds to infection and how, in turn, pathogens manipulate host immunity to improve their chances of survival. Mouse cytomegalovirus (MCMV) is used as a model virus infection, due to its similarity in structure and biology with the human cytomegalovirus (HCMV).

Research theme
- Infectious diseases

Scientific discipline
- Immunology

Keywords
virus, mucosal immune response, pathogenesis

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Details of project — Natural Killer cell and cytomegalovirus interaction

Aim: This research project will examine how NK cell functions are regulated and will seek to gain a more precise understanding of the cytomegalovirus immune evasion strategies.

Human cytomegalovirus (HCMV) is a common pathogen typically encountered in childhood. Although primary infection is readily controlled in healthy individuals, immune response fails to eliminate the virus resulting in latent infection that persists for life. In immunocompromised patients, HCMV is responsible for severe diseases that may lead to life threatening conditions. Mouse cytomegalovirus (MCMV) is very similar in structure and biology to HCMV, hence, MCMV is a widely utilised experimental model. MCMV studies evidenced that Natural Killer (NK) cells play a critical during acute infection, also, individuals with defective NK cells exhibit extreme sensitivity to viruses.

During hundreds of millennia of co-evolution with its host species, cytomegaloviruses have developed numerous immuno-regulatory genes that play an immune evasion role. Several immunoevasins have been identified in both HCMV and MCMV, however, the mechanisms that regulate NK cell antiviral response remain to be precisely understood.

This research project will involve animal experimentation in mouse infected with MCMV. The major techniques will be in vitro NK cell assays, flow cytometry and will also involve molecular biology techniques.
Project references


Research interests

Professor Mariapia Degli-Esposti’s group central focus is to determine the key cellular and molecular interactions that occur in response to viral infection. In recent years this research has provided important contributions to understanding how the immune system responds to infection and how, in turn, pathogens manipulate host immunity to improve their chances of survival. Mouse cytomegalovirus (MCMV) is used as a model virus infection, due to its similarity in structure and biology with the human cytomegalovirus (HCMV).

Research theme

- Infectious diseases/immune evasion

Scientific discipline

- Immunology

Keywords

virus, immune response, NK cells

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**Proposed Project**

Monitoring and evaluating teleophthalmology in Western Australia.

**Brief description**

- **Aim:** an observational study, by consecutive case series, of real-time teleconsultations performed for eye patients in Western Australia.
- **Hypothesis:** teleophthalmology is a safe, accurate and cost-effective means of providing access to specialist services for a subset of patients in rural and remote Western Australia.

**Background**

Teleophthalmology is the delivery of specialist ophthalmic services to patients in a different geographical location, using telecommunications technology. In 2011 a teleophthalmology service commenced in Western Australia. This real-time service operates between a general ophthalmologist based at the Lions Eye Institute, and several general practitioners, optometrists and hospitals in rural and remote Western Australia.

At present, there is a paucity of data on the efficacy of real-time teleophthalmology services, especially relating to patient satisfaction, barriers to utilisation, clinical efficacy and cost-effectiveness. This project proposes to address this gap in evidence by evaluating the teleophthalmology service in Western Australia, identify its utility and limitations, and provide recommendations for future. It is envisaged that the results will be significant and worthy of publication in a medical journal, given the novel nature of the project, potential benefit to patients and relevance to eye care programs in Australia and overseas.

**Methodological Approach**

- **Study design:** prospective, consecutive case series
- **Objective:** to monitor the use and evaluate the effectiveness of teleophthalmology for patients requiring eye care in Western Australia over a defined period of time.
- **Literature review:** published and appropriate unpublished literature on teleophthalmology
- **Data collection:** develop and validate metrics for evaluating episodes of care via teleconsultation; design and maintain a database of teleconsultation episodes of care.
- **Statistical analysis:** dedicated data technical specialist input.
- **Report:** write up results for thesis presentation with secondary aim of journal publication.

**Role of the student**

Perform the following roles under supervision and with support: literature review, data collection, provide input on statistical analysis and first author of the final report.
Lions Eye Institute Honours Projects 2015

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Proposed Project

Monitoring and evaluating a culturally-appropriate teleophthalmology service in Western Australia.

Brief description

- **Aim:** An observational study, by consecutive case series, of real-time teleconsultations performed for eye patients in Western Australia.
- **Hypothesis:** Teleophthalmology is a safe, accurate and cost-effective means of providing access to specialist services for a subset of patients in rural and remote Western Australia.

Background

Teleophthalmology is the delivery of specialist ophthalmic services to patients in a different geographical location, using telecommunications technology. In 2011 a teleophthalmology service commenced in Western Australia. This real-time service operates between a general ophthalmologist based at the Lions Eye Institute, and several general practitioners, optometrists and hospitals in rural and remote Western Australia.

At present, there is a paucity of data on the efficacy of real-time teleophthalmology services, especially relating to patient satisfaction, barriers to utilisation, clinical efficacy and cost-effectiveness. This project proposes to address this gap in evidence by evaluating the teleophthalmology service in Western Australia, identify its utility and limitations, and provide recommendations for future. It is envisaged that the results will be significant and worthy of publication in a medical journal, given the novel nature of the project, potential benefit to patients and relevance to eye care programs in Australia and overseas. While telemedicine has been generally well received by patients and providers, Indigenous Australians’ perceptions of telemedicine are unknown. As many patients managed by video-consultation will be Indigenous, an assessment of whether telemedicine provides a culturally-appropriate model of providing healthcare may also be included. Hence, the findings of this project may have broader relevance to any program that includes telemedicine as a means of healthcare delivery to this population.

Methodological Approach

- **Study design:** Prospective, consecutive case series
- **Objective:** To monitor the use and evaluate the effectiveness of teleophthalmology for patients requiring eye care in Western Australia over a defined period of time.
- **Literature review:** Published and appropriate unpublished literature on teleophthalmology
- **Data collection:** Develop and validate metrics for evaluating episodes of care via teleconsultation; design and maintain a database of teleconsultation episodes of care.
- **Statistical analysis:** Dedicated data technical specialist input.
- **Report:** Write up results for thesis presentation with secondary aim of journal publication.

Role of the student
Perform the following roles under supervision and with support: literature review, data collection, provide input on statistical analysis and first author of the final report.

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Details of project — Induction of Pluripotency in Limbal Stem Cells

The human corneoscleral limbus contains multipotent stem cells that can be isolated and cultured for clinical applications, such as the treatment of limbal stem cell deficiency. Studies in rodents have shown that limbal stem cells can be cultured as floating neurospheres that can be further dedifferentiated to pluripotency without the use of traditional reprogramming techniques that employ transcription factor delivery. Limbal neurospheres (LiNS) express three (SOX2, KLF4 and C-MYC) of the four transcription factors identified as being sufficient for reprogramming cells to pluripotency, lacking only Oct4, the master pluripotency gene. Culture of LiNS in embryonic stem cell conditioned media is sufficient to induce Oct4 expression and an induced pluripotent stem cell phenotype in rodent LiNS, however the induction of pluripotency from primary human LiNS has not yet been reported. In this project the effects of microRNAs on pluripotent gene expression and induction of pluripotency will be examined in human LiNS cultures.

Project references


Research interests
The Ocular Tissue Engineering Laboratory was established in 2011 with the aim of developing stem cell therapies for retinal diseases such as Age-related Macular Degeneration (AMD). Our research interests include the culture and differentiation of adult stem cells, induction of pluripotent and retinal cell fate by cellular reprogramming and extracellular matrix production using macromolecular crowding. With a focus on clinical translation, we have combined these research themes to develop an autologous retinal pigment epithelial patch for the treatment of AMD.

Research theme
- Cellular Reprogramming

Scientific discipline
- Stem Cell Biology

Keywords
pluripotency, induced pluripotent stem cells, limbal stem cells

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