NEW HONOURS PROJECTS AVAILABLE FOR 2014 ENTRY

Impact of early nutrition on brain growth and development in very preterm newborns
Supervisors: A/Prof Jeanie Cheong and Dr Alicia Spittle
Project Site: The Royal Women’s Hospital
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Very preterm infants are at risk of many health and developmental problems in childhood and young adulthood. Because they are born 2-3 months’ before their due date, their organ systems are immature and they are unable to “sustain” many functions that a full term baby can. Among these are the ability to suck and tolerate milk feeds. Often, very preterm babies have a period where nutrition is delivered intravenously (parenteral nutrition) while human milk is slowly introduced over days and weeks. Optimal nutrition may also be impacted on by coincidental illness like infection. Nutrition is an important factor in growth and development, in particular brain development. It is thus important that we try and better understand the impact on early nutrition in very preterm infants on their brain growth and developmental outcome. This project nested within a longitudinal cohort study of growth and development in very preterm infants. This clinical study will involve careful collection of nutritional data and relating this to brain development, as assessed using MRI and developmental outcomes.

Brain Computer Interface using ECoG.
Supervisors: David Grayden, Sam John, Thomas Oxley
Site: Department of Medicine, Royal Melbourne Hospital, The University of Melbourne
Contact: Thomas Oxley thomas.oxley@unimelb.edu.au

**Aim:** The objective of this project is to develop a LabVIEW based Brain Computer Interface (BCI).

**Description:** BCI is a communication system where neural signals such as those obtained by electrocorticography (ECoG) are recorded from the brain and converted into movement of an external actuator. An essential component of a BCI is signal processing involves identifying features in the ECoG signal associated with movement, and converting these features into output commands.

The project will involve:
1) Developing the LabVIEW based software that records neural signals from the brain in a large animal model.
2) Develop self-organized adaptive algorithms to identify and decode patterns of electrical activity associated with movement.
3) Translate decoded patterns into movement of a mechanical actuator.
4) Evaluate the accuracy of the decoding algorithm.

Developing a behavioural ovine model for evaluation of a brain computer interface.
Supervisors: Tom Oxley, Sam John, Clive May.
Site: Department of Medicine, Royal Melbourne Hospital, The University of Melbourne
Contact: Thomas Oxley thomas.oxley@unimelb.edu.au

**Aim:** Develop an ovine model of volitional movement for a proof of principle brain computer interface.

**Description:** Brain computer interfaces rely of detecting changes in the broadband power spectrum. Animal studies evaluating the feasibility of brain computer interfaces use non-human primates and are expensive and not easily accessible. Preliminary experiments show distinct electrophysiological correlates of volitional movement in an ovine model and promises to provide an alternative animal model to evaluate feasibility of Brain computer interfaces. This study seeks to develop behavioural paradigms and experimental setup of volitional movement in an ovine model.
Identification of different states of motor attentiveness in humans.
Supervisors: Tom Oxley, Sam John, David Grayden
Site: Department of Medicine, Royal Melbourne Hospital, The University of Melbourne
Contact: Thomas Oxley thomas.oxley@unimelb.edu.au

Aim: To identify different states of motor attentiveness and intent of volitional movement in human patients.
Description: Electrocorticogram (ECoG) recordings provide a means to evaluate and implement a brain computer interface. Optimal BCI require accurate feature extraction and signal processing to identify electrophysiological correlates of motor events. This project will focus on developing the experimental paradigms and analysis tools to record broadband ECoG from patients participating and identify the change in power spectrums during volitional movement.

Supervisors: Tom Oxley, Sam John, David Grayden, Terrence O’Brien
Site: Department of Medicine, Royal Melbourne Hospital, The University of Melbourne
Contact: Thomas Oxley thomas.oxley@unimelb.edu.au

Aim: To develop an autonomous interface to assist with functional brain mapping.
Description: Functional brain mapping is useful for preoperative planning and decision making during resective brain surgery in neurosurgical patients with conditions such as brain tumours, vascular lesions, and epilepsy. Electrocorticograms are used to map eloquent areas of the brain related to motor and sensory areas that must not be removed. Present techniques require the presence of a clinician to record the functional brain mapping. This project will focus on developing a fully autonomous platform for functional brain mapping using electrocorticograms.

How does treatment with steroids change the course of multiple sclerosis relapses?
Supervisors: Dr Tomas Kalincik, Dr Vilija Jokubaitis and A/Prof Helmut Butzkueven
Project Site: Department of Medicine, Royal Melbourne Hospital, The University of Melbourne
Contact: Tomas Kalincik, E: tomas.kalincik@unimelb.edu.au

Clinical relapses reflecting bouts of inflammatory activity are a typical feature of multiple sclerosis (MS). A common therapeutic approach is acute administration of high-dose intravenous steroids. However, the evidence supporting this approach is scarce.

This project will examine the outcomes of steroid treatment of MS relapses. We hypothesise that intravenous steroids decrease duration of MS relapses and improve recovery. This project is an extension of our recently published work on relapse incidence and phenotype. It will utilise a large longitudinal collection of data recorded in the international observational MS registry based at Melbourne Brain Centre - MSBase.

This project will suit people with interest in statistics and health outcome analysis. During the course of the project, you will become familiar with quasi-randomisation and the analysis of observational data. Knowledge of basic statistics is expected. You will contribute to the evidence-based clinical management of MS.

Managing Oxygen therapy for preterm infants in the Delivery Room
Supervisor: Dr Jennifer Dawson and Professor Peter Davis
Project Site: Newborn Research, The Royal Women’s Hospital
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Preterm infants will often require assistance to breath at birth. Clinicians have many decision to make when managing these infants in the delivery room. We know that how we care for preterm infants in the first minutes after birth can have an impact on infants short term and long term outcome. There are decisions about when to start supplemental oxygen, how much oxygen to use, when should the concentration of oxygen be increased or decreased, and what device should be used to give positive pressure ventilation to support breathing and how much pressure we should use. The newborn Research Centre is currently involved in trials to find the evidence to inform clinical practice. This clinical study will measure the amount of oxygen we use in the delivery room and if the concentration of oxygen administered matches current resuscitation guidelines.

Do older patients have poorer outcomes after epilepsy surgery?
Supervisors: Dr Anne McIntosh, Professor Patrick Kwan.
Project Site: Department of Medicine, Comprehensive Epilepsy Programs at Royal Melbourne Hospital and Austin Health.
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Individuals who have severe epilepsy that is refractory to medication may undergo surgical resection of the seizure focus, usually a lesion (non-malignant) or other structural abnormality. Epilepsy outcome research in the Department of Medicine at Royal Melbourne Hospital and Austin Health offers the opportunity to utilise two large well-established surgical cohorts to study post-surgical outcome and contribute to the growing international evidence base in this area.

Although the majority of patients who have epilepsy surgery achieve seizure freedom or a significant decrease in seizures, not all suitable surgical candidates will be offered this opportunity. Worldwide, older patients are one group where there appears to be a reluctance to offer surgery, possibly due to concerns about increased likelihood of seizure recurrence or complications. The aim of this project is to examine whether older patients have a poor outcome after surgery compared to younger patients.

The student will collate data regarding several factors (i.e. histopathology, surgery type, seizure outcome, cognitive outcome, post-surgical complications) from the medical records of patients who have undergone epilepsy surgery at The Royal Melbourne Hospital or Austin Health. In a number of cases, follow-up telephone interviews with patients will be required in order to obtain up-to-date seizure outcome information. Outcome information will be analysed according to age at surgery.

This information will contribute directly to the assessment, counseling and management of patients undertaking surgery at Austin Health and RMH. The study will contribute to the international epilepsy surgery literature.

The skills expected to be learnt from this project include: Patient telephone interviews, outcomes assessment, clinical epilepsy, statistics.

Differentiation and characterisation of Sensory Neurons derived from Friedreich Ataxia induced Pluripotent Stem Cells.
Supervisors: Dr Mirella Dottori
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Friedreich ataxia (FA) is an autosomal recessive disease characterised by neurodegeneration and cardiomyopathy and is the most common form of all inherited ataxias known to date. The primary and most significant sites of degeneration occurring within the nervous system are peripheral sensory neurons and cerebellar neurons. The cause of FA is due to the presence of a trinucleotide GAA repeat expansion in the first intron of the FXN gene, resulting in an insufficiency of the mitochondrial protein, Frataxin. Reduced levels of Frataxin protein leads to mitochondrial dysfunction, cell toxicity and cell death, particularly within the nervous system and cardiac tissue. In FA research there is a strong need to develop human cellular models of the disease to further study the cellular pathology of FA as well as develop therapies. To meet these needs, we have generated iPS cell lines derived from skin biopsy samples of FA patients. We have shown that the FA iPS cells and their neuronal derivatives retain some of the fundamental molecular and genetic characteristics of this disease, including significantly lower levels of Frataxin protein (less than 30%) and GAA repeat instability within the FXN gene locus. Despite harbouring the genetic characteristics of the disease, neurons derived from FA iPS cells do not show significant susceptibility to cell death or abnormal mitochondrial function. One possible explanation for the lack of phenotype is that only specific neuronal populations are sensitive to low Frataxin levels and/or Frataxin protein levels need to be less than 15% before overt degenerative cellular mechanisms can be identified. These hypotheses are consistent with what is observed in FA patients. This project aims is to address these hypotheses in order to establish an appropriate human FA cellular model. We have recently developed an efficient system for deriving sensory neurons from human stem cells. Furthermore, we have extensive experience in developing transgenic human stem cell lines in order to modify gene expression levels. Using these technologies, we now aim to repeat our analyses of mitochondrial function as well as other cellular functions specifically in sensory neurons from FA iPS cells. These studies will enable us to establish a human cellular model system of FA that can be further utilized to accelerate development of FA treatments.

**Sarcopenia, Physical Performance and Vitamin D in Older Adults**

**Supervisors:** Dr David Scott, A/Professor Kerrie Sanders, Professor Peter Ebeling  
**Project Site:** NWAC Sunshine Hospital, St Albans  
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Sarcopenia is the term used to describe age-related declines in skeletal muscle quality and physical performance. This study will investigate how specific changes in skeletal muscle quality contribute to performance declines and risk of falls in older adults. The study will also examine the association of increased abdominal and intramuscular fat with muscle quality and function, and determine whether vitamin D status plays a role in this relationship. The Honours student will be based at the NorthWest Academic Centre (Sunshine Hospital) for the duration of the project and will have the opportunity to develop skills including administering physical performance tests (such as gait and balance assessment) and radiographic measurement of body composition (using dual-energy X-ray absorptiometry and peripheral quantitative computed tomography). For further information on this project, please contact David Scott using the details listed above.