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Critical Care Research Group (CCRG)

The CCRG is based at the Australia's largest cardiothoracic hospital, The Prince Charles Hospital, and regularly realises the huge potential of integrating technology and biology in combating cardiovascular disease. The group is a multi-disciplinary team consisting of clinicians, scientists, statisticians, allied health professionals and engineers. The CCRG aims to improve both the understanding and use of technologies to improve the outcomes of patients via organ transplantation and mechanical assist device (MAD) options, used by clinicians in the management and treatment of patients suffering from cardiovascular disease.

Since its establishment by Professor John Fraser in 2004, the CCRG has attracted more than \$28 million in grants and industry funding, published over 300 papers, and was awarded the first NHMRC Centre of Research Excellence for MADs. The CCRG also has active ongoing collaborations with The Alfred Hospital and St Vincent's Hospital, which, combined with the CCRG's base location of The Prince Charles Hospital gives the group a strong network across the three major cardiac hospitals in Australia. In addition, the group belongs to multiple national and international research networks, including ECMOnet, EuroELSO, APELSO, ANZICS amongst others. The group specialises in clinically validated large animal models, within a state of the art research facility. CCRG also has an extensive network of collaborators across UQ, and both within Australia and overseas.

Research Projects are available in a number of areas for honours, masters (research/coursework), and PhD students. Projects can range from animal experiments, to biological characterisation of tissue samples, through to translation of research findings to improve current clinical outcomes. Large animal, pre-clinical studies are a major focus of the CCRG, but through collaborations with other research scientists (at UQ and overseas), the group encourages multidisciplinary projects. Students will be expected to apply for research funding, and the group has a strong track-record in mentoring students to obtain novice grants successfully (up to \$10,000 each). Students will also gain valuable experience working with leading clinician researchers from major hospitals around Australia, as well as cutting edge researchers in medical engineering and biomedical science.

Currently available projects:

1. *The Dead Heart Project – When is a dead heart truly dead?*

Students will be involved in a multi-disciplinary team across the 3 biggest cardiac hospitals in Australia. The project aims to improve the quantity and quality of donor hearts through

organ reconditioning and new donor sources, as well as understanding ischemia-induced molecular damage to cardiomyocytes during transplant. The model is clinically relevant with study transplants performed by leading Australian cardiothoracic surgeons.

2. *Endotyping Acute Respiratory Distress Syndrome (ARDS)*

ARDS is a critical illness with unacceptably high mortality rate (up to 45%). Currently, there is no effective treatment, partly due to its heterogeneity nature. Recent retrospective studies proposed the possibility of endotypes among ARDS patients. CCRG is exploring this topic with our established large animal model. The project is in collaboration with international partners, including Queen's University Belfast and UCSF. Students will have the opportunity for a short-term visit to our collaborator in the UK.

3. *Impact of Extra-Corporeal Membrane Oxygenation (ECMO) on leukocytes*

ECMO is a life saving device for patients with severe cardiac and/or respiratory dysfunction. It allows patients to rest in otherwise life-threatening situations. However, mortality remains high. This undesirable outcome is often associated with immune perturbation mediated by the contact of patient blood cells with the foreign surface of ECMO. This project aims to better understand the impact of ECMO on leukocyte fate.

4. *Gastrointestinal bleeding caused by ventricular assist device (VAD)*

Gastrointestinal bleeding is one of the most common complications in patients with continuous flow VAD (Ventricular Assist Devices - artificial mechanical hearts), but the exact cause is unknown. This project involves testing whole blood and endothelial responses to different flow conditions by connecting vascular models to commercially-available VADs (some of these may have been removed from patients.). Students will develop skills in cell culture, blood circuit assembly, flow cytometry and fluorescent microscopy

For more information of the group and available projects, please contact Dr. Jacky Suen (j.suen1@uq.edu.au).

Techniques/Knowledge you will learn in our group may include:

General: experimental design, good laboratory practise, ethics application, site specific approval application, good record keeping, pipetting and dilution technique

In vitro/ex vivo: SDS-PAGE, Western Blot, ELISA, RT-PCR, RNAseq, ddPCR, single cell PCR, immunofluorescence, flow cytometry, confocal microscopy, electronic microscopy (SEM, TEM), mitochondria profiling, oxygraph, organ bath.

In vivo: animal ethics application, animal handling, dissection, tissue/blood handling, blood differential, histology

Clinical/Human: electrocardiogram, extra-corporeal membrane oxygenation, echocardiogram, cardiopulmonary bypass, mechanical ventilation, rotational thromboelastometry (ROTEM), multiplate analysis, electrophysiology, arterial blood gas, ex vivo lung perfusion, patient recruitment process
