Computational modelling for prevention of heart failure following myocardial infarction

Theme: Infection, Immunity & Repair
Reference: MRC19IIRBa Cookson

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Heart attack (myocardial infarction, MI) is the cause of around 37% of heart failure (HF) cases. Current treatment for MI consists of percutaneous coronary intervention, to restore perfusion, and administration of thrombolytic and antiplatelet drugs, to breakdown and prevent clots. However, these are only partially effective; many patients' hearts still undergo remodelling, leading to HF in the following months. New tools for optimising treatments are therefore needed to improve these outcomes. Numerical models have the potential to predict the interplay between complex biological systems and dynamic, mechanical tissue remodelling. The overarching aim is thus to develop computational models of HF, which can be used to aid treatment optimisation.

This DTP project then addresses the "Repair" strand of the "Infection, Immunity and Repair" research theme. To underpin these efforts, the specific aim of the project is to link perfusion with myocardial remodelling.

To achieve this aim, we have identified three key objectives. The first is to develop a validated computational model of myocardial perfusion in the mouse heart – in the initial stages this will be a static model, but later variations could include the effects of mechanical contraction, building on existing models and code based on porcine data. The second objective is to build a model of myocardial remodelling to predict structural changes (primary end point). The third objective is to use these models to predict the effect of varying treatment, such as ACE inhibitors.

In order to build and validate this model, various types of experimental data will be used, which is currently being gathered by another PhD student supervised by this team. This data will derive from a mouse model of MI, with contraction assessed by echocardiography. Perfusion will be imaged and quantified using micro-PET-CT, with N-13 ammonia tracer, at points throughout MI and subsequent dilation of the heart. The project involves working at the boundary between the life sciences and physical sciences. PET imaging requires knowledge and understanding of both nuclear physics and physiology, while biomechanics requires both mechanical engineering and physiology. This combination of different techniques makes this a challenging project, as students usually complete undergraduate/MSc degrees in either bio or physical sciences. However, the project is feasible: all supervisors are experts in their respective fields and have interdisciplinary skills; they will provide hands on training and assistance as required. The links with the Translational Biomedical Research Network and the Translational Biomedical Research Centre mean that the project has knowledge transfer and translation at its core, and will link with an existing porcine model of heart failure.

IMPORTANT: In order to apply for this project, you should apply using the DTP's online application form: https://cardiff.onlinesurveys.ac.uk/gw4-biomed-mrc-dtp-student-2019

More information on the application process may be found here:
http://www.gw4biomed.ac.uk/doctoral-students/

APPLICATIONS OPEN ON 24 SEPTEMBER AND CLOSE ON 23 NOVEMBER 2018.

You do NOT need to apply to the University of Bath at this stage – only those applicants who are successful in obtaining an offer of funding form the DTP will be required to submit an application to study at Bath.