Potential Supervisors

Professor Stephen Payne

I am an Associate Professor in Biomedical Engineering and a Tutorial Fellow at Keble College. My research is based in the Institute of Biomedical Engineering, part of the Department of Engineering Science (and winner of a Queen's Anniversary Prize for Higher and Further Education in 2015). The research focus of my group is cerebral blood flow and metabolism, in particular Cerebral Autoregulation. This is the term used to describe the many complex processes that act to ensure that cerebral blood flow is maintained near constant despite changes in blood pressure, and its failure has been shown in many diseases, including both stroke and dementia. Dementia is now the leading cause of death in the UK with stroke also being a major cause of death and long-term disability. My work aims to understand how the brain regulates blood flow across the cerebral vasculature and how this is affected in diseased states.

Since my appointment in 2006, I have raised £1.2M in grants as a PI and been a Co-Investigator on three other major grants totalling £11.3M. I have published 3 books and 90 papers in international journals (h-index of 21; over 100 co-authors), and supervised 23 DPhil students to successful completion (1 further awaiting viva) as well as having managed 13 post-doctoral research assistants. In 2016 I published the first book on Cerebral Autoregulation; this was described by one reviewer as a 'landmark' in the field. I am also currently serving as Chair of the Cerebral Autoregulation Research Network (CARNet), the international group in this area, and am the Chair of the Organising Committee for the 8th International Conference on Cerebral Autoregulation (to be held in Oxford in June 2018).

My work is highly interdisciplinary and all of my grants have clinical co-investigators, with many of them also having industrial partners. The primary clinical application has been ischaemic stroke patients, where cerebral autoregulation is known to change dynamically, and where the management of blood pressure and assessment of cerebral autoregulation are both critical in maintaining cerebral blood flow on an individual patient basis. This work has most recently been funded by EPSRC in a three-way partnership with the Universities of Leicester and Southampton, with a substantial number of cross-centre publications.

In recent years, my group has also been working on multi-scale modelling of the cerebral vasculature from the smallest (diameter < 10 μm) to the largest (diameter > 1 mm) vessels; this is driven by the finding that regulation can occur across the whole vascular bed. We have been the first group to develop the tools to cross these scales such that we can integrate the behaviour across all length scales and hence link the behaviour to imaging data in humans. This will be a key part of my most recent ERC grant, INSIST, which will validate our models using a database of many thousands of ischaemic stroke patients and use these models to predict clinical outcome in response to a number of different treatments. I have also recently published the first book on a quantitative approach to cerebral blood flow and metabolism that will move the field towards a better understanding of the need for mathematical models in interpreting the behaviour of such a complex system.

Software Tools Developed

Go-Smart - aims to build a generic open-source software simulation environment for the planning of image guided percutaneous Minimally Invasive Cancer Treatment (MICT).