Aston University
Life & Health Sciences

Rigorous, Relevant
Research

Cellular and Clinical Neuroimaging

▶ Introduction

Communication between different cells within the brain is achieved by release of small molecules from the signaling cells which are received by receptors on target cells. Individual brain cells propagate these signals via a series of electrical currents across their membranes. Ineffective or uncontrolled communication between cells, possibly because of abnormal receptor activity, can lead to abnormal electrical impulses and can contribute to disease states such as epilepsy, Parkinson's disease and Alzheimer's disease. Researchers at Aston University are developing translational research methodologies which will allow them to understand which changes in molecules or receptors mediate changes in the electrophysiology of the brain; this offers the potential to design new drugs to intervene with disease processes. Our research aims to develop novel pharmacological, surgical and non-invasive investigations/interventions in neurological and neurodegenerative diseases.

The approaches adopted by our team of molecular biologists, pharmacologists, physicists and clinical neurophysiologists include:

- Molecular manipulation and expression of receptors for structure/function analysis;
- In vitro electrophysiology and imaging;
- Clinical neuroimaging studies using MEG, fMRI, EEG and TMS.

▶ Sponsors and funders

The Wellcome Trust, The Alzheimer's Research Trust, Parkinson's Disease Society UK, EU, BBSRC, EPSRC, MRC, BHF, EPSRC, RCUK, European Commission, Lord Dowding Fund, The Hadwen Trust, The Birmingham Children's Hospital Research Foundation, Glaxo SK and ReGen Therapeutics Plc.
Academic collaborations are an important aspect of the group's activities which hosts e-MEP, a European Union consortium comprising 17 partners across the EU.

▶ Key projects

- Structure-activity and biophysical analyses of membrane proteins and receptors, with particular focus on GPCRs and ligand gated ion channels;
- Generation and control of neuronal activity by glial transmitters in the brain during health and pathological conditions (Alzheimer's disease and Epilepsy);
- Understanding why epilepsy is triggered and what electromagnetic changes occur in the brains of susceptible patients and in tissue models;
- Development of mathematical models of cortical activity and their verification in humans;
- Development of humane research techniques which facilitate drug development and toxicity testing.

▶ Key significant findings

1. Used MEG imaging to view the brain's response to pain. Gastroenterology 2005, 128; 610-619.
2. Developed tools to understand MEG data which are used worldwide. Human Brain Mapping 2003, 18; 1-12.
3. Discovered the organization of a receptor involved in emesis and anxiety which will aid new drug discovery. Proceedings of the National Academy of Sciences 2005, 102; 12596-12600.
4. First to show that specialised brain cells, astrocytes, excite brain neurones using calcium. Nature Neuroscience 2001, 4; 803-812.
5. Demonstrated NMDA autoreceptors at synapses in a region of the brain affected by epilepsy. Journal of Neurophysiology 2001, 86; 06-13.

▶ Recent publications can be viewed in the following journals

- Biochemistry 2006, 45; 12976-85.
- Protein Expression and Purification 2006, 56; 110-120.
- European Journal of Neuroscience 2007, 25; 2081-2092.
- Neuroscience 2008, 151; 386-395.
- Neuroimage 2007, 35: 518-30.
- Epilepsia 2007, 48; 96-100.

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