Hamilton Institute

Extracellular Potassium Dynamics and Epileptogenesis

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Wednesday, 21st January, 2009

Extracellular ion concentrations change as a function of neuronal activity and also represent important factors influencing the dynamic state of a population of neurons. In particular, relatively small changes in extracellular potassium concentration mediate substantial changes in neuronal excitability and intrinsic firing patterns. While experimental approaches are limited in their ability to shed light on the dynamic feedback interaction between ion concentration and neural activity, computational models and dynamic system theory provide powerful tools to study activity-dependent modulation of intrinsic excitability mediated by extracellular ion concentration dynamics.

Drawing on results obtained with biophysical network models of the thalamocortical system, I will discuss the potential role of extracellular potassium concentration dynamics in the generation of epileptoform activity in neocortical networks. Detailed bifurcation analysis of a model pyramidal cell revealed a bistability with hysteresis between two distinct firing modes (tonic firing and slow bursting) for mildly elevated extracellular potassium. In neocortical network models, this bistability gives rise to previously unexplained slow alternating epochs of fast runs and slow bursting as recorded *in vivo* during neocortical electrographic seizures in cats and in human patients with the Lennox-Gastaut syndrome. We conclude that extracellular potassium concentration dynamics may play an important role in the generation of seizures.

Venue: Seminar Room, Hamilton Institute, Rye Hall, NUI Maynooth

Time: 2.00 - 3.00pm (followed by tea/coffee)

Travel directions are available at www.hamilton.ie

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