CDB SEMINAR

Don Newgreen/Kerry Landman

Murdoch Children's Research Institute / University of Melbourne

Thursday, June 17, 2010

16:00 - 17:30 C1F CDB Auditorium

Rules for Enteric Nervous System Assembly—Biological and Mathematical Insights

Summary

The formation of the enteric nervous system is perhaps the most tractable neurodevelopmental event in vertebrate embryogenesis. This involves the colonisation of the wall of the tubular gut from one end to the other by a population of proliferating and migrating cells derived from the neural crest. At the same time the tubular gut is also growing, mainly by elongation. The actively migrating neural crest cells initially form a network of intertwined chains with a looser migratory "front". Later, the population organisation evolves as cells increasingly differentiate into neurons and extend axons. The cell distribution gradually alters as cells aggregate to form relatively regularly sized and spaced groups with both neurons and non-neurons, and with interconnecting strands of cells and neurites. This is the regular ganglionated lattice characteristic of the enteric nervous system.

We will discuss biologically and with mathematical models, the general properties of cell movement, proliferation, adhesion and differentiation from which might emerge: 1) migrating cells which form chains; 2) chains being relatively stable despite the constituent cells being unstable; 3) evolution of regularly sized and spaced cell aggregates. The influence of field (gut) growth and the role of stochastic processes will be discussed.

Host:
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Biosketch: Don Newgreen

Don Newgreen's PhD studies were at the University of Melbourne followed by positions at the Institute d'Embryologie et Biologie Moleculaire (Nogent-sur-Marne, France), the Max-Planck-Institute for Developmental Biology (Tübingen, Germany), Dept of Cell and Structural Biology, Manchester University (UK), Dept of Paediatric Surgery, Westmead Hospital (Sydney, Australia) and Murdoch Children's Research Institute (Melbourne, Australia).

Don Newgreen's major research interest has been how cell movement is controlled in development, particularly centred on the neural crest system. He has helped popularise notions of cross-modulation of epithelial-mesenchymal transition effectors, and negative controls of migration via anti-adhesive and repulsive guidance molecules. These developmental studies have also been extended to the pathological cell movements of invasive cancers. Recently he has, with Professor Kerry Landman of Melbourne University, pursued mathematical modelling to understand migratory outcomes when several effector systems vary and interact simultaneously. This has produced a new understanding of the fundamental errors leading to the neural crest birth defect Hirschsprung's disease. In turn, this has stimulated his interest in possible neural crest stem cell therapies for Hirschsprung's disease.

Biosketch: Kerry Landman

Kerry Landman obtained her PhD in mathematics from The University of Melbourne. She spent six years working as an applied mathematician in USA, at MIT, the Environmental Protection Agency and Southern Methodist University, Texas. She returned to Melbourne to join Siromath, a mathematical sciences consulting firm, before joining the Department of Mathematics and Statistics at the University of Melbourne. She directed the Mathematics-in-Industry Study Group from 1993-1997.

Kerry Landman is an applied mathematician committed to cross-disciplinary research. Her research interests are in mathematical modelling with application to industrial, environmental, biological, and medical areas. She has used mathematical modelling to gain an understanding of a diverse group of topics, including shape changes of red blood cells, indoor pollution by radon gas, heat loss in houses, consolidation and filtration of minerals waste, cooking of wheat grains for breakfast cereal manufacture and the design of windscreen wipers. For the past few years, she has been collaborating intensively with Don Newgreen on understanding the development of the enteric nervous system, as well as other developmental systems.