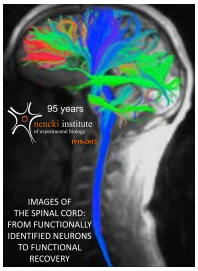

95 years
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Symposium on: IMAGES OF THE SPINAL CORD: FROM FUNCTIONALLY IDENTIFIED NEURONS TO FUNCTIONAL RECOVERY

Monday, 25th November 2013

Abstracts

1. **"Cytoskeletal Mechanisms of Axonal Growth and Regeneration"**

Frank Bradke
Axonal Growth and Regeneration, German Center for Neurodegenerative Diseases (DZNE), Bonn, Germany

Neurons are the cellular basis of the circuits of our nervous system that allow us to sense the environment, control our muscles and, sometimes, even to think. In these circuits, neurons fulfill very different functions at different part of the cells, including signal reception, integration and propagation. This is possible because neurons have a high degree of asymmetry (or polarity). We want to understand how neurons develop their polarity. How do neurons generate an axon? While this is an interesting question by itself, answers will also allow us to reactivate the polarity program under pathological conditions, such as a spinal injury, to induce axon regeneration.

2. **"Imaging Motor Microcircuits in the Spinal Cord."**

Robert Brownstone
Departments of Surgery (Neurosurgery) and Medical Neuroscience, Dalhousie University Halifax, Canada

The use of multiple modalities - electrophysiology, molecular biology, and anatomy - combined with neuronal activity imaging, can shed light on our understanding of spinal microcircuits involved in the control of movement. This approach, including two-photon imaging of calcium signals in discrete genetically-defined neurons, has led to the discovery of previously unknown spinal cord and brainstem neuronal populations. These discoveries provide the basis for a new understanding of neural systems that control a variety of motor behaviors.

3. **"Multi-parametric MRI of spinal cord injury: methodological challenges"**

Julien Cohen-Adad
Institute of Biomedical Engineering, Ecole Polytechnique de Montreal, Montreal, Canada

Multi-parametric MRI consists in combining several quantitative methods based on MRI, in order to gain confidence in assessing structural impairment after spinal cord injury. These methods include: atrophy measurement, magnetization transfer imaging and diffusion imaging. The two latter techniques are mainly used to assess integrity of white matter spinal pathways, given their sensitivity and specificity to axon demyelination and degeneration. However, diffusion imaging is prone to severe artifacts in the spinal cord, hence should be cautiously interpreted before being applied to patients. In this talk we will review the main challenges of these techniques and propose overcoming solutions**.**

4. **”Visualizing the impact of training and neurotrophins on functional recovery”**
   Julita Czarkowska-Bauch & Małgorzata Skup
   Department of Neurophysiology, Nencki Institute of Experimental Biology PAN, Warsaw, Poland

Activation of BDNF-mediated signaling has been postulated to account for motor improvement in exercised spinal animals. Treadmill training of spinal rats moderately improves locomotion, increases synaptic inputs to some motoneurons and causes a modest increase in BDNF expression, suggesting that an additional supply of BDNF is necessary to enhance recovery. AAV-inducing long-term overexpression of BDNF in the spinal cord has been employed by several groups, resulting in significant upregulation of BDNF protein, early improvement of locomotion, and hyperexcitability of the spinal network. We will reveal plausible neurotransmitter contributions to the mechanisms for those effects and present alternative methods of increasing endogenous pools of BDNF and other neurotrophins.

5. **”Nanomedicine: Contribution of Nanoparticles toward Imaging of Central Nervous System and Stem Cells”**
   Mirosław Janowski
   Mossakowski Medical Research Centre PA, Wrasaw, Poland & Johns Hopkins University School of Medicine, Baltimore, USA

The opportunities arising from the development of nanotechnology have tremendous impact on research and clinical practice. Large-scale production of nanoparticles has been a milestone, especially for medical imaging including use of hybrid nanostructures for multimodal (MRI/CT/PET/optical) imaging enhancing visualization capabilities. Iron-oxide nanoparticles (Feraheme) are an excellent example of potentially clinically applicable tool for both transcatheter intra-arterial contrast-enhanced MRI to depict regional cerebral flow and for stem cell labeling. We have shown using large animal model (Dog) that this methodology is applicable for predicting and monitoring intra-arterial cell or drug delivery to the brain and spinal cord.

6. **”Probing Neural Circuits Controlling Walking: Moving Forward”**
   Ole Kiehn
   Karolinska Institute, Mammalian Locomotor Laboratory, Department of Neuroscience Stockholm, Sweden

Locomotion is in large part controlled by neuronal circuits in the spinal cord itself. Experiments combining electrophysiology and molecular mouse genetics to dissect the spinal locomotor networks have started to shed new light on the organization of the mammalian locomotor

circuits. In this talk, I will discuss findings that have revealed the role of designated spinal populations of neurons that serve key network functions in controlling left-right coordination and excitatory interneuron networks engaged in rhythm-generation. I will also discuss how network selection leads to variable speeds of locomotor outputs. Our experiments provide insights to the principal mode of operation of a large-scale mammalian motor circuit.

7. **”Recovery of locomotion after partial spinal cord lesions in cats using behavioral, electrophysiological and imaging techniques”**
Serge Rossignol, Marina Martinez, Hugo Delivet-Mongrain & Julien Cohen-Adad
Faculty of Medicine, Université de Montréal, Montreal, Canada

I will briefly summarize our work on partial spinal lesions in cats using a dual spinal lesion paradigm. This work utilizes kinematic, electromyography and MRI imaging. These studies show the importance of plastic mechanisms occurring within the spinal circuitry below the partial lesion. Essentially, cats recover locomotion after a hemisection. When a complete section is performed 3 weeks after the hemisection, cats can walk within 24 hours compare to 2-3 weeks in cats with a single spinal section not preceded by a hemisection. We have also shown the importance of locomotor training in the locomotor recovery.

8. **"The Role of Diffusion Tensor Imaging in Assessment of Spinal Cord Injury"**
Marek J. Sąsiadek, Anna Banaszek & Joanna Bladowska
Department of Radiology, Wroclaw Medical University, Wrocław, Poland

Diffusion tensor imaging (DTI) is an advanced magnetic resonance technique, which enables morphological and quantitative assessment of the white matter. However due to technical difficulties, DTI has been rarely used in the spinal cord diseases. We discuss the physical principles of the DTI, technical aspects, as well as current and future applications in different pathological processes of the spinal cord and spinal canal. DTI seems to be very promising method in spinal cord trauma, spinal canal tumors, degenerative myelopathy, as well as demyelinating and infectious diseases of the spinal cord. By measuring fractional anisotropy (FA) and other parameters it provides the quantitative assessment of the spinal cord injury.

9. **”The Role of Serotonin in Control of Locomotor Movements Revealed Using Behavioral, Electrophysiological and Imaging Techniques”**
Urszula Sławińska & Larry M. Jordan
Department of Neurophysiology Nencki Institute of Experimental Biology PAN, Warsaw, Poland & Department of Physiology, Spinal Cord Research Centre, University of Manitoba, Winnipeg, Canada

Serotonin neurons located in the medulla are able to initiate locomotor activity. This effect is exerted by actions on motoneurons and on neurons of the locomotor CPG. Motoneuron and interneuron excitability is increased, and putative CPG interneurons display oscillatory behavior in response to serotonin receptor activation. The medullary serotonergic nuclei play multiple roles in the control of locomotion, and they can be differentially controlled. Replacement of serotonergic neurons by grafting provides differential control over multiple components of the spinal locomotor circuitry through specific serotonin receptors, and activation of these serotonin receptors can restore locomotor movements after spinal cord injury.

10. ”Stem Cells and Biomaterials for Treatment of Spinal Cord Injury”

Eva Sykova
Institute of Experimental Medicine ASCR, Prague, Czech Republic

Stem cells have been investigated for their therapeutic potential in spinal cord injury (SCI). A balloon-induced compression lesion in rats was followed by the transplantation of MSC or SPC-01 cells labeled in culture with iron-oxide nanoparticles for MRI tracking. Various biocompatible hydrogels (degradable and nondegradable), including those based on non-woven nanofibres, have been developed for bridging tissue defects and for use as 3D stem cell carriers. Animals implanted with MSC or SPC-01 cells showed functional improvement. Scaffolds seeded with MSC as well as with SPC-01 cells bridged the lesion site in chronic SCI and improved motor and sensory scores**.**

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