"VISIONARIUM"

QUINDECIMUS

XV

at Tvärminne Zoological Station,
University of Helsinki,
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Tvärminne Zoological Station 1903

The purpose of the Visionarium meeting is to continue in the spirit of the former "Planeringsgruppen" (Swedish Medical Council 1968-2001) by bringing together scientists in vision research to informal meetings to present on-going and planned research and to discuss and establish future projects. Projects in the planning stage are as welcome as already finished projects. Convener and organizer has since the beginning 2002 been Dr. Magnus Lindström (magnus.lindstrom@helsinki.fi).

neuronal cell survival and glial reactivity using morphological staining and immunohistochemistry (IHC). We also analysed biopsies from Rhegmatous Retinal Detachment (RRD) patients using IHC for Gal-3 and Iba1, as well as vitreous samples from RRD patients using ELISA for Gal-3.

Results: The porcine retinal explants cultured with Gal-3 inhibitors TD139 and IC261471 significantly increased photoreceptor survival compared to corresponding controls. Inversely, cultures with added Gal-3 to the medium displayed significantly reduced outer nuclear layer (ONL)- thickness. The conservation of photoreceptor thickness seemed to correlate negatively with an increased presence of microglia in the ONL. Furthermore, the supplementation of Gal-3 increased microglial markers in the photoreceptor layer. The RRD biopsies appeared to show an upregulation of Gal-3, and vitreous levels of Gal-3 in RRD patients was significantly higher compared to controls.

Conclusions: The porcine model involves several retinal insults, and result in severe retinal degeneration as well as a microglial activation and migration into the retinal nuclear layers. Here we can report that blocking the pro- inflammatory cytokine Gal-3, required for microglial phagocytosis in the ischemic mice brain, results in a higher degree of photoreceptor survival in the pig. Gal-3 also correlates with human RRD pathology. Our results suggests that Gal-3 may have potential as a pharmaceutical target for retinal diseases

HORIZONTAL CELL NETWORKS CAN ACCOUNT FOR FAR CENTER-SURROUND INTERACTIONS IN THE GOLDFISH RETINA

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Introduction. Responses of ganglion cells of several types (direction-selective (DS GC), orientation-selective (OS GC), and cells with sustained activity) to colour stimuli presented on a colour background as well as the influence of illumination of far periphery on the responses of these cells were examined in our experiments. To find out the possible wiring diagrams of connections of these ganglion cells the computational models were built, and the experimental results were tested on that models.

The models. Each model consists of three identical neural networks, serving three non-interacting colour channels: red, green and blue. Each network contains the cone layer (with cones of the appropriate spectral sensitivity), and one horizontal cell connected with all cones of the appropriate colour channel. Further, there are layers of bipolar cells and an output ganglion cell which receives signals from bipolar cells. The connections of the ganglion cell with bipolar cells, and the types of bipolar cells used in the models are determined by the nature of responses of the simulated ganglion cell to selective colour stimulation (ON, OFF, or ON-OFF for each colour channel) and by the observed interactions of colour channels in the receptive field [1, 2]. Two parts of the retina are independently stimulated in the model: (1) the receptive field of the simulated ganglion cell and (2) the rest of the retina – the far surround.

Results of simulation. 1) In accordance with the experiments on DS GCs in the fish retina the model demonstrates univariance of cell responses to colour stimulation. 2) The responses of OS GCs demonstrate very complex colour interactions in the receptive field. Two possible wiring diagrams of bipolar cell connections were suggested. Further experiments are required to determine what circuit is correct. 3) The illumination of the far surround does not affect the response of motion detectors in the model. In real physiological experiments there was, as a rule, some influence of the far surround on the response of these cells, but we could not find any predictable effect. 4) The units with sustained activity (dark and light spontaneous units) respond

to the difference of illuminations between the receptive field and the far surround. Simple models of those cells are suggested, and further experiments will permit to refine these models. Thus the results of experiments on the models correspond to the real experimental data.

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References

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ACTIVE PHOTOLOCATION OR "ECHOLOCATION WITH LIGHT" IN FISHES

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Marine fishes possess a diversity of ways to modify and re-emit incoming light from their eyes. We study the possibility that this can generate perceptible reflections in the eyes of other organisms and may help to detect cryptic prey and predators. I shall present first experimental and theoretical evidence for the functionality of "active photolocation" of prey in our main model species, a small, benthic triplefin from the Mediterranean.

ENGINEERING MULTI-ELECTRODE PATCH-CLAMP SYSTEM TO QUANTIFY POPULATION ACTIVITY IN NEURAL CIRCUITS

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The human brain contains almost 100 billion neurons. These neurons form distinct neural circuits that underlie the computational power of the brain. The challenges in identifying desired cell types and recording multiple cells at the same time have to large extent limited our possibility to understand the functional principles of neural circuits. Simultaneous patch clamp recording from multiple well-defined neurons at the same time would give an excellent opportunity to obtain a deeper mechanistic understanding of neural circuit function. Our goal is to build a state-of-the-art multi-electrode patch-clamp system integrated with software that enables us to study the retina. In addition to the recording system, we aim to have a data-analysis environment allowing effective sharing of data and reproducibility of data analysis across labs.

We have built a quadruple patch-clamp system to study in-vitro retinal circuits. The choice of hardware and mechanics was made, so that it can be extended to eight electrode patch clamp system. At software level, we developed Matlab toolboxes for 1) light source calibration, 2) online analysis and 3) more detailed offline analysis, as an extension to an existing data acquisition system (Symphony open source software).