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Subtypes of Retinal Müller Glial Cells as Adaptations to Specialized Vision

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Project description:

Müller radial glial cells are the dominant glia of all vertebrate retinae but their morphological and functional features vary greatly among the species, and even within a given retina. We hypothesize that much of this variability is caused by adaptation to the particular structural and functional requirements of the species-specific and/or topographically modified neuronal circuits which may differ greatly in many aspects (e.g., photopic = cone driven vs. scotopic = rod dominated; vascularized vs. avascular retina), and thus should be supported by different glial subtypes. The aim of our project is to test this hypothesis by examining causal relationships between accessible morpho-functional parameters of Müller cells and the (e.g., photopic / scotopic) specialization of their immediate neuronal environment (partner cells). Physiological experiments (Ca2+ imaging) will be carried out on acutely isolated retinae and freshly dissociated Müller cells, and will be complemented by immunohistochemical studies on fixed tissue / cells (revealing the expression of functionally relevant ion channels, ligand receptors, transporter molecules, and metabolic enzymes by different subtypes of Müller cells) and by an assessment of the biomechanical properties of retinal pieces and isolated Müller cells. It is of central interest to understand the situation in the human (primate) retina with its transition between Müller cells serving pure cone driven photopic vision (in the fovea) and cells supporting rod dominated scotopic vision (in the periphery) within the very same retina. As only a limited number of human and monkey retinae will be available, mice will be used as a model of the strictly scotopic and vacularized retina, and birds, also possessing a fovea, will serve as models for the cone dominant (photopic, avascular) retina. Additional studies will be performed on the rabbit retina which is characterized by a particularly wide variety of Müller cell subtypes (rabbit retina is mainly avacular with the exeption of the very central retina). After having established stable correlations between several key features of Müller cell subtypes and their photopically vs. scotopically specialized neuronal partners, we will focus upon the mechanisms generating these glial adaptations. As one approach, animal models with specific rod vs. cone degenerations will be studied; it is expected that the morpho-functional tuning of the Müller cell subtypes will change under these conditions. In addition, it will be tested whether the application of circuit-specific signal molecules can modify the subtype-specialization of Müller cells.

Quelle:
https://gepris.dfg.de/gepris/projekt/255011267