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ARVO Annual Meeting Abstract | July 2019

The responses of cone photoreceptors to retinal detachment in the rat

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Investigative Ophthalmology & Visual Science July 2019, Vol.60, 6603. doi:https://doi.org/

Abstract

Purpose : Rodents are increasingly used to study signaling pathways activated during retinal detachment (RD), and, to test the effectiveness of putative neuroprotective strategies. Yet, relative to the extensive body of work conducted on cats, there exist fewer data pertaining to the effects of RD on the different retinal cell types in rodents. Clinically, the fate of cones following RD is of particular importance. Data from cats have shown that RD induces differing effects on rods and cones. The goal of the current study was to shed light on the responses of cone photoreceptors to RD in the rat.

Methods : RD was induced in the right eyes of Sprague-Dawley rats via subretinal injection of sodium hyaluronate; left eyes served as untouched controls. Animals were humanely killed between 1 and 28 days after surgery. Eyes were removed and either placed in Davidson's fixative and subsequently embedded in paraffin for transverse sectioning of the retina, or, were fixed in neutral buffered formalin and dissected as retinal wholemounts. Tissue sections and retinal wholemounts were processed for single- or double-labeling immunohistochemistry using standard methodologies.

Results : From wholemount quantifications, the number of S-cones during RD was reduced to 12.9±4.2% (1 week), 7.3±2.6% (2 weeks) and 9.2±4.9% (4 weeks) of the total recorded in the intact retina. The number of M/L-cones during RD was 59.2±13.1% (1 week), 24.4±8.4% (2 weeks) and 22.4±4.9.2% (4 weeks) of the intact retina. From analysis of transverse sections, expression of peanut agglutinin (PNA), arrestin, and peroxiredoxin-1 in cones was largely unchanged at 1 day after RD. In contrast, most S-opsin labelling was lost, M/L-opsin segments were typically short and distorted, whilst

neuron-specific enolase in cones was reduced. Between 3 and 7 days after RD, cone “deconstruction” continued, with variably reduced expression of arrestin and peroxiredoxin-1, and disorganised and collapsed labelling of PNA. Cone markers were broadly consistent between 1 and 4 weeks after RD. Of note, expression was often patchy, likely being related to height of RD.

Conclusions : Expression of S-opsin is lost earlier than M/L-opsin after RD in rats, while other cone markers, notably PNA and arrestin, are more resilient. A significant proportion of cones survive for 4 weeks after RD. The present results have implications for cone identification and quantification during experimental studies of RD.

This abstract was presented at the 2019 ARVO Annual Meeting, held in Vancouver, Canada, April 28 - May 2, 2019.