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UCSB Makes Important Advances in Studies of Retinal Detachment

Scientists at the University of California, Santa Barbara's Neuroscience Research Institute are reporting significant advances in their studies of retinal detachment:

· They have discovered that cellular changes that occur in the retinas of animals with retinal detachments also occur in humans. This implies that experimental therapies that reduce cellular damage in animals have a high likelihood of being successful in humans.

· They have determined that oxygen therapy for retinal detachment, which they pioneered, can be highly successful in animals even when it is delayed, suggesting that it should be successful in humans as well.

In the January 2005 issue of Investigative Ophthalmology and Visual Science, the international team of scientists describes changes that occur in detached human retinas. In this study, Steven K. Fisher, professor of molecular, cellular and developmental biology, and Geoffrey P. Lewis, research scientist, headed the UCSB effort, collaborating with colleagues at the Moorfields Eye Hospital and the Institute of Ophthalmology at University College London.

Understanding the "glial" response is a key aspect of this study.

Glial cells are known as the "supporting cells" of the nervous system. The central nervous system (CNS) consists of both neurons and glial cells. Glial cells actually

outnumber neurons in the CNS but their functions are poorly understood. It is known that glial cells surround neurons, hold them in place and supply nutrients to neurons. They insulate neurons from each other and also destroy and remove dead neurons.

The reaction of the glial cells to retinal detachment is critical to the success of surgery to correct retinal detachment. The glial response is part of an important medical condition called "proliferative vitreoretinopathy" (PVR). This condition is characterized by the growth of glial cells on the surface of the retina. In response to unknown stimuli, these cells begin to contract and can cause the retina to tear or re-detach. In humans, PVR is the most common cause of failure of retinal reattachment surgery. It occurs in five to 10 percent of all cases.

Essentially the glial cells form scar tissue in PVR. Scar tissue in one location causes the re-detachment of the retina, in another it blocks the regeneration of neurons and vision does not return. According to this and earlier studies, the data indicate that glial cell remodeling can play a clear role in the return of good vision following successful reattachment surgery. What has been a surprising new result in all of the recent studies is the extent of neuronal remodeling that occurs during the time the retina is detached.

"The structural remodeling of retinal neurons in animals following detachment has been assumed to alter synaptic connections between nerve cells and in doing so have an effect on visual outcome including reduced visual acuity or changes in color vision," said Lewis.

Photoreceptors in the eyes are among the most highly metabolic cells in the body, using more energy than any others. Because of this, the UCSB researchers decided to test the use of extra oxygen to help maintain the cells after a retinal detachment. First reported by the UCSB researchers in 1999, the therapy has proved remarkably effective and is now being used by some ophthalmologists prior to surgery. Recently the UCSB team reported refinements of these results.

Normal room air has about 21 percent oxygen. In these first studies, the effects of oxygen were examined under "ideal" conditions. That is, oxygen therapy at 70 percent was begun immediately after creating a retinal detachment. However, these ideal conditions would not likely be encountered in a clinical situation because it would not be possible to administer oxygen to human patients immediately after a retinal detachment occurs.

Therefore, a new study was undertaken in which elevated oxygen was administered 24 hours after creating a detachment, thus more closely mimicking conditions commonly encountered in human patients. The results were published by the UCSB scientists in American Journal of Ophthalmology last summer. In this case, neuronal cell death and nerve cell remodeling was greatly reduced by comparison to the animals breathing normal room air, although the glial cell response was less affected than in the experiments with delivery of immediate elevated oxygen.

Assuming that it is desirable to reduce cell death and prevent the remodeling of nerve cells in detachment patients, the simple administration of elevated oxygen between the time of diagnosis and surgical repair may result in more rapid and improved recovery after reattachment surgery. Future research will include determining the effectiveness of this hyperoxia therapy when administered both before and after reattachment surgery, and methods for better inhibition of the undesirable cellular effects that lead to PVR.

This research has broad implications since the cell types involved (neurons and glia) are the same as those in the brain and spinal cord. The UCSB effort is one of a handful of research labs in the world that are studying retinal detachment in this way. The work at UCSB is unique in that the researchers have specialized using high resolution microscopy techniques to precisely map changes in protein expression and morphology in the cells.

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Steven Fisher Web Page

Geoff Lewis Web Page

Neuroscience Research Institute

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