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Pluripotent Stem Cells Shown To Generate New Retinal Cells Necessary For Vision, Study Finds

Pluripotent stem cells — those, like embryonic stem cells, that give rise to almost every type of cell in the body — can be converted into the different classes of retinal cells necessary for vision, according to a new study from researchers at SUNY Upstate Medical University.

This research points to exciting new possibilities for preventing or reversing the disabling vision loss caused by age-related macular degeneration, diabetes retinopathy, retinitis pigmentosa, glaucoma, and other diseases that damage the retina, the layer of light-sensitive nerve cells that line the back of the eye. The research was presented at Neuroscience 2008, the annual meeting of the Society for Neuroscience in Washington, D.C.

"Vision is lost in these diseases because one or more of the seven retinal cell types die," said the study's lead author, Michael Ezra Zuber, Ph.D., assistant professor of ophthalmology and adjunct assistant professor of biochemistry and molecular biology at SUNY Upstate Medical University. "Current treatments can slow these diseases' progression, but they can't replace lost retinal cells. Pluripotent cells offer a promising starting point from which to generate new retinal cells."

Zuber and his colleagues knew that cultured pluripotent cells could be induced to express some retinal cell genes, but they didn't know if all retinal cell classes could be generated or if the cells would have the ability to form a functioning retina. To test that hypothesis, the scientists turned to pluripotent Xenopus laevis (frog) cells.
Under normal conditions, pluripotent frog cells form only skin tissue. The scientists were able, however, to convert the pluripotent cells to retinal cells by forcing them to express the eye field transcription factor (or EFTF) genes. The reprogrammed cells formed all seven classes of retinal cells normally found in the eyes, including the retinal ganglion cells, which have axons (optic nerves) that extend to the brain.

Furthermore, these new cells eventually formed into functioning eyes. When tested, tadpoles used their induced eyes to detect light and to engage in a vision-based behavior. The scientists also found a population of self-renewing cells in the periphery of the induced retinas, suggesting that EFTF-induced cells also formed adult retinal stem cells.

"The goal of regenerative medicine is to replace dead or dying cells," said Zuber. "The retina, like all body organs, contains multiple, distinct cell types. Therefore, successful recovery from blindness due to injury or disease will require the functional replacement of multiple retinal cell types. Our results demonstrate that pluripotent cells can be purposely altered to generate all the functional retinal cell classes necessary for vision."
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