Nanoparticles help researchers deliver steroids to retina

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Hitching a ride into the retina on nanoparticles called dendrimers offers a new way to treat age-related macular degeneration and retinitis pigmentosa. A collaborative research study among investigators at Wayne State University, the Mayo Clinic and Johns Hopkins Medicine shows that steroids attached to the dendrimers targeted the damage-causing cells associated with neuroinflammation, leaving the rest of the eye unaffected and preserving vision.

The principal authors of the study, Raymond Iezzi, M.D. (Mayo Clinic ophthalmologist) and Rangaramanujam Kannan, Ph.D. (faculty of ophthalmology at The Wilmer Eye Institute of Johns Hopkins) have developed a clinically relevant, targeted, sustained-release drug delivery system using a simple nanodevice construct. The experimental work in rat models was initiated and substantially conducted at Wayne State University, and showed that one intravitreal administration of the nanodevice in microgram quantities could offer neuroprotection at least for a month, and appears in the journal, *Biomaterials* (33(3), 979-988).

Both dry age-related macular degeneration and retinitis pigmentosa are caused by neuroinflammation, which progressively damages the retina and can lead to blindness. Macular degeneration is the primary cause of vision loss in older Americans, affecting more than 7 million people, according to the National Institutes of Health (NIH). Retinitis pigmentosa encompasses many genetic conditions affecting the retina and impacts 1 in 4,000 Americans, the NIH estimates.

"There is no cure for these diseases, said Iezzi. "An effective treatment could offer hope to hundreds of millions of patients worldwide. We tested the dendrimer delivery system in rats that develop neuroinflammation leading to retinal degeneration. The target was activated microglial cells, the immune cells in charge of cleaning up dead and dying material in the eye. When activated, these cells cause damage via neuroinflammation — a hallmark of each disease."

"Dendrimers are tree-like, non-cytotoxic polymeric drug delivery vehicles (~ 4 nm). Surprisingly, the activated microglia in the degenerating retina appeared to eat the dendrimer selectively and retain them for at least a month. The drug is released from the dendrimer in a sustained fashion inside these cells, offering targeted neuroprotection to the retina," said Kannan.

The treatment reduced neuroinflammation in the rat model and protected vision by preventing injury to photoreceptors in the retina. Although the steroid offers only temporary protection, the treatment as a whole provides sustained relief from neuroinflammation, the study found. The researchers believe that this patent-pending technology with significant translational potential will be advanced further, through this multi-university collaboration among Johns Hopkins, Mayo Clinic and Wayne State. The study was funded by grants from the Ligon Research Center of Vision at Wayne State University, the Ralph C. Wilson Medical Research Foundation, Office of the Vice President for Research at Wayne State University, and Research to Prevent Blindness.

Provided by Wayne State University

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