A new protein treatment for glaucoma?

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A Northwestern Medicine study in mice has identified new treatment targets for glaucoma, including preventing a severe pediatric form of glaucoma, as well as uncovering a possible new class of therapy for the most common form of glaucoma in adults.

In people with high pressure glaucoma, fluid in the eye doesn't properly drain and builds up pressure on the optic nerve, leading to vision loss. It affects 60 million people worldwide and is the most common cause of blindness in people over 60 years old.

While there are a few treatments available for open angle glaucoma, the most common form of glaucoma in adults (eye drops, oral medication, laser treatments), there are no cures, and a severe form of glaucoma in children between birth and three years old known as primary congenital glaucoma can only be treated with surgery.

"Although primary congenital glaucoma is much rarer than open angle glaucoma, it is devastating for children," said corresponding author Dr. Susan Quaggin, chief of nephrology and hypertension in the Department of Medicine at Northwestern University Feinberg School of Medicine. "New treatments and new classes of treatments are urgently needed to slow vision loss in both forms.

Using gene editing, the scientists in the study developed new models of glaucoma in mice that resembled primary congenital glaucoma. By injecting a new, long-lasting and non-toxic protein treatment (Hepta-ANGPT1) into mice, the scientists were able to replace the function of genes that, when mutated, cause glaucoma. With this injectable treatment, the scientists also successfully prevented glaucoma from ever forming in one model. This same therapy, when injected into the eyes of healthy adult mice, reduced pressure in the eyes, supporting it as a possible new class of therapy for the most common cause of glaucoma in adults (high intraocular pressure open angle glaucoma).

The study, "Cellular crosstalk regulates the aqueous humor outflow pathway and provides new targets for glaucoma therapies," was published today, Oct. 18, in the journal *Nature Communications*.

The next step is to develop the appropriate delivery system for the successful new protein treatment in patients and bring it to production, Quaggin said.

Additionally, the scientists used bioinformatics and single cell RNA sequence data to understand and identify glaucoma pathways that can be explored in the future for additional therapeutic targets for the disease, such as ones that regulate communication with a specialized blood vessel in the eye (Schlemm's canal) that is important for draining fluid and maintaining normal eye pressure.

"Having a treatment that can promote remodeling and/or growth of a defective Schlemm's canal to treat glaucoma would be fantastic," Quaggin said. "These studies are the first step to that goal.

"Our hope is that this study leads to the first targeted therapy that effectively promotes (aqueous humor) fluid outflow from the front of an eye, reversing the underlying biologic defect in patients with glaucoma."

Other Northwestern co-authors are Ben Thompson (first), Dr. Jing Jin, Pan Liu and medical student Raj Purohit. This study builds on major teamwork and an ongoing collaboration with University of Madison-Wisconsin co-authors Terri Young and Stuart Thomson.

More information: Benjamin R. Thomson et al, Cellular crosstalk regulates the aqueous humor outflow pathway and provides new targets for glaucoma therapies, *Nature Communications* (2021). DOI: 10.1038/s41467-021-26346-0

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