Retinal imaging technology for early detection of Alzheimer's disease

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Alzheimer's disease is the leading cause of dementia in the U.S., with approximately 5.4 million currently affected and an estimated 16 million

by 2050. Damage to the brain from Alzheimer's disease occurs years before patients exhibit symptoms. Attempted therapies have been unsuccessful largely because there is no measurable indicator—or biomarker—for Alzheimer's disease before it is already symptomatic and advanced.

The eye's retina is considered the developmental extension of the brain and can be accessed non-invasively. In a recently published study in the *ACS Chemical Neuroscience* journal, University of Minnesota Professors Robert Vince and Swati More researched a promising retinal biomarker using a hyperspectral imaging technique for early Alzheimer's disease detection. The hyperspectral imaging technique allows for the analysis of a wide spectrum of light outside of—but not excluding—primary colors that detect the biomarker of Alzheimer's disease.

The research team examined the potential of retinal hyperspectral imaging to detect biochemical changes present at the early stages of Alzheimer's disease. Specifically, the technique characterizes light scatter changes in the retina of Alzheimer's disease patients when compared with healthy participants.

The process, which has been used in preclinical trials and a human pilot study, scans a patient's eye to detect small quantities of a protein long before they collect in large enough clusters to form plaques in the brain—a biological sign of Alzheimer's disease progression. The test is non-invasive and is conducted in less than 10 minutes.

For the study, nineteen Alzheimer's disease patients who had memory scores ranging from mild cognitive impairment (MCI) to advanced Alzheimer's disease were scanned and compared to non-Alzheimer's disease participants of the same age. Light scatter changes were recorded from the patients' different retinal areas (e.g., optic disc, nerve fiber layer of the peripapillary retina, perifoveal retina and the central retina)

using a specialized camera coupled to a custom designed spectral imaging system.

An analysis of the retinal hyperspectral imaging (rHSI) data displayed that:

- the highest detectable light signal was obtained in the MCI cohort when compared to the advanced Alzheimer's disease participants;
- the signal suggests higher sensitivity of this technique toward early stages of the disease;
- the rHSI signature also correlated with memory scores in the MCI participants;
- the rHSI signature is unaffected by pre-existing eye conditions, such as mild to moderate cataracts or glaucoma, peripapillary atrophy, etc.

"The preliminary results from this study are promising and have laid the foundation for next steps involving rigorous validation of the technique in a clinical setting," said Swati More, an associate professor in the Center for Drug Design, College of Pharmacy. "In the future, the rHSI-based retinal biomarker screening could be part of an annual eye exam, with results potentially dictating follow-up evaluations or therapeutic intervention."

"While Alzheimer's disease cannot yet be treated with the intent to cure, early diagnosis with retinal screening can facilitate interventions with available therapeutics," said Robert Vince, director of the Center for Drug Design. "This could add years of productive, quality time to the patient's lifespan. The rHSI technique has shown promise and could be particularly valuable for identifying high-risk individuals for Alzheimer's disease by starting periodic retinal screening at an early age."

"In collaboration with our industry partner, RetiSpec, we hope to

accelerate clinical development of this early detection technique and provide existing or new treatments the best chance for success," added Vince.

More information: Swati S. More et al, In Vivo Assessment of Retinal Biomarkers by Hyperspectral Imaging: Early Detection of Alzheimer's Disease, *ACS Chemical Neuroscience* (2019). DOI: 10.1021/acschemneuro.9b00331

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