Variations in eye structure and function may reveal features of early-stage Alzheimer's disease

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Investigators at the Cedars-Sinai Regenerative Medicine Institute have discovered eye abnormalities that may help reveal features of early-stage Alzheimer's disease. Using a novel laboratory rat model of Alzheimer's disease and high-resolution imaging techniques, researchers correlated variations of the eye structure, to identify initial indicators of the disease.

Alzheimer's disease is the leading cause of dementia, which is characterized by loss of memory and a progressive decline in cognitive function. To date, more than 26 million people are estimated to suffer from the disease and the number is expected to quadruple by 2050. Despite the disease being described over a century ago, treatment and understanding of the disease remain rather limited.

"Detecting changes in the brain that indicate Alzheimer's disease can be an extremely challenging task," said Shaomei Wang, MD, PhD, lead author of the study and an associate professor in the Regenerative Medicine Institute and Department of Biomedical Sciences. "By using the eye as a window to brain activity and function, we may be able to diagnose patients sooner and give them more time to prepare for the future. Options may include earlier enrollment in clinical trials, developing support networks and dealing with any financial and legal matters."

Using both animal models and postmortem human retinas from donors with Alzheimer's disease, researchers found changes in the retinal pigment epithelial layer, which harbors the supportive cells located in the back of the eye, and in the thickness of the choroidal layer that has blood vessels providing nutrients to the retina. Changes in these two regions were detected using sophisticated, state-of-the-art imaging and immunological techniques.

With high-resolution, microscopic imaging and visual acuity measurements, investigators were able to monitor tissue degeneration in the cell layer and vascular layer at the back of the eye, as well as decline in visual function, that were strongly associated with Alzheimer's disease.

"Greater magnitude in these eye abnormalities may mean a greater chance of a patient having Alzheimer's disease," said Alexander Ljubimov, PhD, director of the Eye Program within the Regenerative Medicine Institute and co-author of the study. "We found that a rat model showed similar signs to the human ailment in the eye. If true in a larger number of humans, these findings may be used to study Alzheimer's disease mechanisms and test potential drugs."

Though additional research is needed to investigate the mechanisms of these ocular changes in relation to changes in the brain, investigators hope to ultimately aid early diagnosis of Alzheimer's disease by studying the most approachable part of the central nervous system: the eye. Cedars-Sinai has been at the cutting edge of studies on the eye and Alzheimer's disease with a previous report showing amyloid plaques, a hallmark of Alzheimer's disease, also build up in the eye using a similar animal model of the disease.

"It is fascinating that the eye may provide such a window to the brain and eventually predict diseases such as Alzheimer's, although more human studies are now needed to confirm this animal work," said Clive Svendsen, PhD, director of the Cedars-Sinai Regenerative Medicine Institute and a co-author on the study. Other members of the Regenerative Medicine Institute Eye Program, include Yu Chun Tsai, PhD, a post-doctoral fellow; and Bin Lu, MD,

PhD, and Sergey Girman, PhD, both project scientists.

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