Artifical Intelligence (AI)-based Quantification of Vascular Lesions in Fundus Fluorescein Angiography

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AuthorBlock: *Vinodhini Jayananthan[1], Tyler Heisler Taylor[1], Aman Kumar[1], EILEEN SANZ[1], Nagaraj Kerur[1]*

[1]Ophthalmology, The Ohio State University, Columbus, Ohio, United States;

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Purpose

Fundus Fluorescein Angiography (FFA) is a common tool for evaluating retinal neovascularization and vascular leakage in eye diseases like retinopathy of prematurity (ROP), diabetic retinopathy (DR), and neovascular age-related macular degeneration (nAMD). Quantifying vascular leakage in FFA is a widely used endpoint in preclinical animal models. Traditional methods for assessing vascular lesions in FFA images are labor-intensive and time-consuming. To overcome this, we developed an AI-assisted analysis pipeline for efficient quantification of vascular lesions in FFA images

Methods

We utilized the AI-integrated Nikon NIS-Elements NIS.ai suite for our study, employing an AI-based analysis pipeline trained on FFA images from two mouse models of ocular angiogenesis: (1) *Vldlr*$^{-/-}$ mouse, representing spontaneous pathological neovascularization involving retina and choroid, and (2) laser-induced choroidal neovascularization (CNV), a model of nAMD. Initial manual segmentation defined vascular lesions in FFA images, serving as the training set for the AI component in NIS software. The dataset included 16 diverse images, featuring instances with and without lesions of varied morphologies, sizes, and positions. We refined the pipeline's accuracy through additional supervision and training on curated images

Results

The AI pipeline initially recognized and analyzed vascular lesions in FFA images but required supervision for improved accuracy. After additional training on curated images, we observed a significant performance improvement, ensuring accurate lesion identification while excluding non-lesion regions and prominent blood vessels

Conclusions

Our research introduces a novel approach to address the labor-intensive and time-consuming nature of quantifying vascular lesions in Fundus Fluorescein Angiography (FFA) images. The developed AI-assisted analysis pipeline, integrated with the NIS.ai suite, demonstrated consistent recognition and analysis of vascular lesions in FFA images. Initial challenges in accuracy were successfully mitigated through additional training on curated images, showcasing a significant improvement in performance

Layman Abstract (optional): Provide a 50-200 word description of your work that non-scientists can understand. Describe the big picture and the implications of your findings, not the study itself and the associated details.

Fundus Fluorescein Angiography (FFA) is a crucial tool for studying eye diseases like diabetic retinopathy and macular degeneration. However, current methods for analyzing eye images are labor-intensive and time-consuming. To address this, we created a smart computer program (AI-assisted pipeline) that learns from images to quickly identify and measure bloodvessels growth in eye issues. We tested it on images from mice with eye problems and improved its accuracy by teaching it with carefully selected images. Our research introduces a faster and more efficient way to understand and diagnose eye conditions using advanced technology.