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Utilizing neural network models on optical coherence tomography angiography biomarkers to enhance diagnosis of primary open angle glaucoma

Nicholas Riina; Alon Harris; Brent A Siesky; Louis R. Pasquale; James C Tsai; Salimeh Yasaei Sekeh; Barbara Wirostko; Julia Arciero; Brendan Fry; George Eckert; Alice Chandra Verticchio Vercellin; Gal Antman; Paul A Sidoti; Giovanna Guidoboni

+ Author Affiliations & Notes

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Abstract

Purpose : To use machine learning (ML), specifically neural network models, to identify the most relevant clinical measurements for the diagnosis of primary open angle glaucoma (POAG).

Methods : Neural network models, also known as multi-layer perceptrons (MLPs), were trained on a dataset comprised of 144 glaucoma patients and 149 healthy subjects. The base model used only intraocular pressure (IOP), systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR) to diagnose glaucoma. The following models were given the same base parameters in addition to one of the following assessed via optical coherence tomography angiography (OCTA) (Tables 1 & 2): vascular features, structural features, choroidal thickness, or average retinal nerve fiber layer (RNFL) and average ganglion cell complex (GCC) thickness only. The models were then evaluated for their accuracy in diagnosing POAG on the testing data that is a subset of data that was not used for the MLP training.

Results : Neural Network Models of three different sizes were each trained in 10 separate instances to calculate average testing accuracy (Table 1). The accuracies of the models were compared, and the distribution of accuracies was used in an independent samples T-test to determine whether model accuracy significantly differed from the base model. As seen in Table 1, the vascular and structural models both had significantly higher accuracies than the base model, with the vascular (0.805) slightly outperforming the structural model (0.792). The GCC+RNFL model and the model containing all structural and vascular features were also significantly more accurate than the base model, with the only non-significantly different model being the choroid thickness model.

Conclusions : Neural Network models indicate that OCTA ONH vascular biomarkers are equally useful for ML diagnosis of glaucoma when compared to structural features alone. Combining OCTA vascular biomarkers with OCT structural parameters while utilizing ML or other artificial intelligence (AI) modeling approaches may enhance glaucoma diagnostics.

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Test Accuracy from each Model, Averaged over 10 trials.

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Optical coherence tomography angiography (OCTA) structural and vascular parameters.