

Clinical Features Distinguishing Diabetic Retinopathy Severity Using Artificial Intelligence

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Background and Hypothesis:

1 in 29 American diabetics suffer from diabetic retinopathy (DR), the weakening of blood vessels in the retina. DR goes undetected in nearly 50% of diabetics, allowing DR to steal the vision of many Americans. We hypothesize that increasing the rate and ease of diagnosing DR by introducing artificial intelligence-based methods in primary medical clinics will increase the long-term preservation of ocular health in diabetic patients.

Project Methods:

This retrospective cohort study was conducted under approval from the Institutional Review Board of Indiana University School of Medicine. Images were deidentified and no consent was taken due to the nature of this retrospective study. We categorized 676 patient files based upon HbA1c, severity of non-proliferative diabetic retinopathy (NPDR), and proliferative diabetic retinopathy (PDR). Retinal images were annotated to identify common features of DR: microaneurysms, hemorrhages, cotton wool spots, exudates, and neovascularization. The VGG Image Annotator application used for annotations allowed us to save structure coordinates into a separate database for future training of the artificial intelligence system.

Results:

228 (33.7%) of patients were diagnosed with diabetes, and 143 (62.7%) of those were diagnosed with DR. Two-sample t tests found significant differences between the HbA1c values of all diabetics compared to diabetics without retinopathy ($p < 0.007$) and between all severities of DR versus diabetics without retinopathy ($p < 0.002$). 283 eyes were diagnosed with a form of DR in this study: 37 mild NPDR, 42 moderate NPDR, 56 severe NPDR, and 148 PDR eyes.

Potential Impact:

With the dataset of coordinates and HbA1c values from this experiment, we aim to train an artificial intelligence system to diagnose DR through retinal imaging. The goal of this system is to be conveniently used in primary medical clinics to increase the detection rate of DR to preserve the ocular health of millions of future Americans.