Predicting Development Of Abnormal Standard Visual Fields In Ocular Hypertensive Eyes: Machine Learning Classifiers And Statpac-like Analysis

PA Sample[1,A], MH Goldbaum[1,A], K Chan[1,B], C Boden[1,A], T-W Lee[1,B], A Boehm[1,A], C Vasile[1,A], T Sejnowski[2], CA Johnson[3] and RN Weinreb[1,A]

[A] Glaucoma Center Ophthalmology[B] Institute for Neural Computation[1] University of California San Diego La Jolla CA
[2] Computational Neurobiology Laboratories Salk Institute La Jolla CA
[3] Discoveries in Sight Devers Eye Institute Portland OR

Commercial Relationships: **P.A. Sample**, None; **M.H. Goldbaum**, None; **K. Chan**, None; **C. Boden**, None; **T. Lee**, None; **A. Boehm**, None; **C. Vasile**, None; **T. Sejnowski**, None; **C.A. Johnson**, None; **R.N. Weinreb**, None.
Grant Identification: Support: EY08208, LM05759, EY03424, RPB

Abstract

Purpose: To compare the ability of several learning machine classifiers to identify development of abnormal fields at follow-up in ocular hypertensive eyes that had had normal fields at baseline.
Methods: The visual fields of 114 eyes of 114 ocular hypertensive patients followed for a minimum of four years with standard automated perimetry (SAP) and stereo optic disc photographs were assessed. Fields were classified as normal or abnormal based on Statpac-like analysis (STAT). Several machine classifiers that previously successfully separated SAP 24-2 fields from normal eyes and eyes with glaucomatous optic neuropathy were evaluated, including support vector machines with linear (SVMl) and Gaussian (SVMg) kernels, a mixture of Gaussian classifier (MoG), a constrained MoG (QDF) and a mixture of generalized Gaussian (MGG). Specificity was set to 96% for STAT determination and each of the classifiers using data from 94 normal eyes evaluated longitudinally. Confirmation of abnormality on two successive visual fields was required.
Results: The mean number (± sd) of fields was 7.89 ± 3.04 over 5.89 ± 2.40 years. 32% (36/114) of the eyes converted to abnormal fields based on STAT. Of these, all were identified by one or more of the machine classifiers earlier by an average gap in years of 4.12 ±1.78 (QDF), 4.39±2.92 (SVMl), 4.43±2.75 (SVMg), 3.39±1.55 (MoG), and 3.28±1.59 (MGG). SVMg showed the best agreement with the presence of GON at 94% (32/34 converts).
Conclusion: The attractive aspect of machine classifiers is their ability to adapt to the data without the constraints imposed by statistical classifiers. This adaptation allowed the machine classifiers to identify abnormality in visual field converts much earlier than traditional methods.
Supported by NIH Grants EY08208 (PAS), LM05759 (MHG), EY03424 (CJ), and Research to Prevent Blindness (PAS)

Keywords: 624 visual fields • 511 perimetry