Local Retinal Morphology Prior to the Onset of Neovascular AMD: A Topographic Analysis using Machine Learning

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Purpose and Motivation

In patients with intermediate age-related macular degeneration (AMD), the risk of progression to neovascular AMD is highly heterogeneous [1] and variable and the prognostic signs are unclear. We utilized machine learning to predict at which topographical location neovascular AMD lesions develop.

Materials and Methods

OCT scans (512x128x1024 voxels, Cirrus) of fellow eyes of patients with choroidal neovascularization (CNV) undergoing regular monthly imaging were processed and registered at the time of advanced AMD onset as well as 1, 3, 6, 9 and 12 months prior.

Patients: 86 eyes with PED, and 27 eyes without PED

Image Computing and Analysis

Graph-based Retinal Layer segmentation [2]
Deep learning based IRF/SRF Fluid segmentation [3]
Deep learning based Hyperreflective Foci (HRF) segmentation [4]

Identification of neovascular AMD local onset

Type I: PED area used to denote the onset location
Type II: SRF area should mark the onset. But SRF spill can be extensive
Type III: IRF area used to denote the onset location

A total of 2D different topographic 2D feature maps were computed and rescaled to a 16x16 grid. A machine learning classifier (random forest) was trained to predict the local onset of neovascular AMD for each grid cell.

Results

Two-fold cross-validation at grid cell-level 1-month prior to the onset

Conclusions

Automated analysis of OCT biomarkers makes possible a personalized and localized prediction of neovascular AMD conversion
- PED develops at the location of drusen and is very predictable.
- IRF local development prediction is difficult but first signs start to appear 3-6 months prior to the onset.
A step toward understanding the retinal characteristics and changes preceding the onset of advanced AMD.

References


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