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Automated classification of age-related macular degeneration using choroidal optical coherence tomography imaging – a pilot study

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Abstract

Purpose : Choroidal vascular changes are evident in age-related macular degeneration (AMD) using histology. However, current disease classification using *in vivo* imaging techniques is based predominantly on retinal features. We performed a retrospective analysis to test the viability of using choroidal optical coherence tomography (OCT) imaging for classifying AMD disease stage.

Methods : Three-dimensional (3-D) long-wavelength (1040nm) OCT images were obtained from eyes with neovascular AMD (n=7), early AMD (n=7), and healthy age-similar controls (n=7). These 20° x 20° (512 x 512 x 1024 pixel) macular scans were classified based on retinal appearance into the disease groups by three masked observers. This was taken as ground truth for the classification algorithm. The choroid was then manually labelled as a closed contour on 20 randomly selected scans per 3-D image (a total of 140 B-scans per group). Texture features were extracted from this region using a Gabor filter bank and non-linear energy transformation. Feature descriptors were used to train three different learning models; random decision forests, support vector machines (SVM) and deep neural networks, for each known disease stage. Confusion matrices were constructed for 10-fold, 2-fold, and leave-one-out cross-validation, to assess classification accuracy under each condition.

Results : A 10-fold cross validation achieved a mean classification accuracy of 94.7%, 97.1% and 84.7% for random forests, SVM and neural networks respectively. A 2-fold cross validation achieved classification accuracy of 88.7%, 94.4% and 78.1% respectively. Leave-one-out cross-validation (representing a clinical diagnosis scenario) achieved 53.2%, 53.4% and 50.5% accuracy respectively. These values are considerably higher than chance (33.3%). In all cases, the classification accuracy was lowest for the early AMD group.

Conclusions : This machine learning approach to automated AMD classification is feasible, and may be a promising method of making clinical diagnoses and determining intervention strategies. Due to the retrospective nature of this pilot study, the techniques described will be applied to a larger dataset of disease and control images, optimized for choroidal visualization.

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