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Fluorescence Lifetime Imaging Ophthalmoscopy in Diabetic Retinopathy

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Footnotes

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Abstract

Purpose : To investigate metabolic byproducts from diabetic retinopathy by fundus autofluorescence (FAF) lifetime imaging (FLIO) and to discriminate patients from healthy controls.

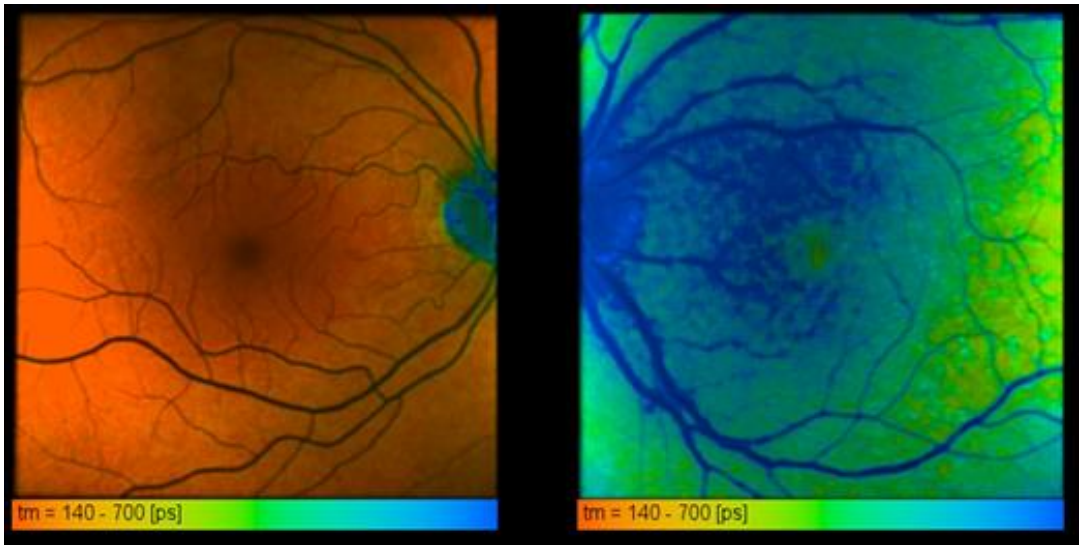
Methods : 33 patients suffering from non-proliferative diabetic retinopathy (NPDR) and 28 age-matched controls were subjected to retinal fluorescence lifetime measurement using FLIO (Heidelberg Engineering, Heidelberg, Germany). Autofluorescence of a 30 degree retinal field was excited by picosecond laser pulses (75 ps FWHM) at 468 nm and fluorescence decay over time was recorded in two spectral channels (498-560nm and 560-720nm). FAF decays were approximated by a series of three exponential functions (least square fit) in each pixel of the FAF image resulting in three lifetimes (τ1-τ3), and three respective amplitudes (a1-a3). Main outcome measure was the amplitude-weighted mean lifetime τm. All parameters were averaged over the subfields of the standard ETDRS-grid centered at the macula.

Results : FAF lifetimes τ1-τ3 as well as tm were extended in the patients compared to controls (Man-Whitney-U-test, $p<0.05$, fig. 1). This was found predominantly in the short-wavelength channel for the inner ring of the ETDRS-grid: τm=333±141ps vs. 220±79ps ($p=0.001$). Statistically independent FLIO-parameters were combined in a logistic regression model. A sensitivity of 90.1% and a specificity of 71.4% were found for the discrimination of NPDR-patients (area under the ROC-curve: 0.865).

Conclusions : Independent from other clinical signs of NPDR, FLIO can hint on diabetic alterations at the posterior pole of the eye. The extension of fluorescence lifetimes, predominantly at short wavelengths, may be explained by the accumulation of advanced

glycation end products which showed long lifetimes in previous in-vitro investigations peaking at 500 nm. FLIO should be considered as a new imaging technique capable to detect specific fluorophores at the fundus with possible pathognomonic implication.

This is an abstract that was submitted for the 2016 ARVO Annual Meeting, held in Seattle, Wash., May 1-5, 2016.



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Color-coded mean FAF lifetime (τm) images of a control subject (left) and a NPDR patient (right).