INVESTIGATION OF CELL METABOLISM BY FLIM AND PLIM

A. Rueck\textsuperscript{a}, J. Breymayer\textsuperscript{a}, D. Bisinger\textsuperscript{a}, E. M. Schneider\textsuperscript{b}, L. Peiffer\textsuperscript{b}, P. Schäfer\textsuperscript{c}, L. Merthan\textsuperscript{c}, B. von Einem\textsuperscript{c}, C.A.F. von Arnim\textsuperscript{c}, S. Kalinina\textsuperscript{a}

\textsuperscript{a}University Ulm, Core Facility Optical Microscopy N24, Albert-Einstein-Allee 11, 89081 Ulm, Germany
\textsuperscript{b}Section Experimental Anesthesiology, University Hospital Ulm, Albert Einstein Allee 23, 89081 Ulm, Germany
\textsuperscript{c}Dept. of Neurology, University Hospital Ulm, Oberer Eselsberg 45, 89081 Ulm, Germany
E-mail: angelika.rueck@uni-ulm.de

KEY WORDS: FLIM, PLIM, SLIM, TCSPC, autofluorescence, NADH, Phosphorescence, OXPHOS, glycolysis, pO\textsubscript{2}, cell metabolism, oral mucosa cells, larynx carcinoma

Cell metabolism in general and energy content in greater detail can be determined by the analysis of chemical reactions providing ATP, FAD\textsuperscript{+} and NAD(P)H. Glycolysis and oxidative phosphorylation (OXPHOS) are the key players in energy conserving mechanisms. It is well accepted that both reactions go along with changes of the fluorescence lifetime of NADH and FAD. The time resolved fluorescence characteristics of NADH and FAD are therefore achieving increased interest in fluorescence guided diagnosis of various diseases. However, as observed in a variety of investigations, the situation is complex and the result is influenced by other parameters like oxidative stress or tissue architecture. In this context, the observation of a “negative” Warburg effect is just one example\textsuperscript{1}. Consecutively, fluorescence lifetime measurements addressed by imaging (FLIM) of NADH and FAD does not always correlate with cell metabolism. Moreover, oxygen tension has to be taken into account in order to understand the underlying reasons for metabolic alterations. Importantly, phosphorescence lifetime imaging (PLIM) is a new method to observe oxygen tension.

Within this presentation the basic mechanisms and relations of FLIM, PLIM and cell metabolism will be discussed and clinically relevant applications will be demonstrated.