Drug quantification in turbid media by fluorescence imaging combined with light-absorption correction using white Monte Carlo simulations

Accurate quantification of photosensitizers is in many cases a critical issue in photodynamic therapy. As a noninvasive and sensitive tool, fluorescence imaging has attracted particular interest for quantification in pre-clinical research. However, due to the absorption of excitation and emission light by turbid media, such as biological tissue, the detected fluorescence signal does not have a simple and unique dependence on the fluorophore concentration for different tissues, but depends in a complex way on other parameters as well. For this reason, little has been done on drug quantification in vivo by the fluorescence imaging technique. In this paper we present a novel approach to compensate for the light absorption in homogeneous turbid media both for the excitation and emission light, utilizing time-resolved fluorescence white Monte Carlo simulations combined with the Beer-Lambert law. This method shows that the corrected fluorescence intensity is almost proportional to the absolute fluorophore concentration. The results on controllable tissue phantoms and murine tissues are presented and show good correlations between the evaluated fluorescence intensities after the light-absorption correction and absolute fluorophore concentrations. These results suggest that the technique potentially provides the means to quantify the fluorophore concentration from fluorescence images. © 2011 Society of Photo-Optical Instrumentation Engineers (SPIE).
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