Enhancing the Properties of Chlorin e4 as Porphyrinic Photosensitizer by Polymer Encapsulation

I. Gjuroski[1], N. Schnidrig[1], E. Girousi[1], J. Furrer[1], M. Vermathen[1]

[1]University of Berne

Polymer nanoparticles are well suited delivery systems for porphyrin photosensitizers in photodynamic therapy (PDT). Photolon® is an approved polyvinylpyrrolidone (PVP) complex with chlorin e6 (Ce6) for medical application. Polymer carrier nanoparticles can promote porphyrin disaggregation, and enhance solubility and stability under physiological conditions, overcoming the drawbacks arising from porphyrin intrinsic propensity for aggregation, thus improving the efficiency of PDT.

Previously we have reported the polymer matrices- PVP [1] and the triblock copolymer Kolliphor P188 (KP) [2] as suitable systems for encapsulating various amino acid derivatives of chlorin e6 (xCe). Moreover, we have studied the xCe aggregate structures by NMR-spectroscopy showing that small modifications on the xCe side chains can have a large impact on the aggregation behavior. Accordingly, Ce4 forms highly aggregated species in aqueous solutions. [3]

This study was aimed at assessing the previously applied block copolymer micelles (BCMs) as well as PVP as suitable carriers for Ce4. UV-VIS-, NMR- and Fluorescence-spectroscopy as well as Imaging flow cytometry were applied as complementary techniques to characterize the polymer-Ce4 systems with a focus on the structural characterization, polymer disaggregation capability, Ce4 solubility and stability under physiological conditions. The results indicated high efficiency of KP-BCMs towards disaggregation and encapsulation of Ce4, improving Ce4 solubility and stability in the presence of serum proteins. Compared to the previously investigated xCe, the efficiency in disaggregation of KP-based BCMs is comparable good for both, highly and less aggregating chlorin species. However, binding properties and thus stability seemed to be improved for the more hydrophobic Ce4 as opposed to the more amphiphilic counterparts xCe. In addition, cellular uptake of both KP- and PVP-encapsulated Ce4 was enhanced (see contribution of E. Girousi).

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