

Title:

Treatment Planning for Interstitial Photodynamic Therapy and Limitations due to the spatial photosensitizer distribution

Abstract:

The feasibility of reliable treatment planning for interstitial Photodynamic Therapy (iPDT) is actively investigated by academic and industrial groups. Underlying dosimetry ideally requires knowledge of the spatial distribution of photon, photosensitizer, and oxygen concentrations. Progress has been made to know the photon density when the light absorption and scattering properties are known, preferably for each individual; however, population-average optical properties might be sufficient. The presence of an oxygen concentration gradient from the proliferating rim towards the tumour core is well established, as is the fact that photodynamic consumption is augmenting this gradient; undertreatment of the malignancy core does not appear to be a clinical problem.

The presentation will briefly introduce the PDT dose concept underlying the work, introduce the light propagation software with examples for the bladder, vertebra, brain, and pancreas, and introduce the iPDT Treatment Planning concept developed in Toronto.

A limitation of the current planning process is predicting the personalized average or spatial photosensitizer concentrations. Blood flow and volume, imaged by MRI, were shown to predict the local oxygen delivery and were also evaluated as predictors for local photosensitizers accumulation. However, *in vivo* experiments demonstrated that the spatial blood flow and volume does not provide sufficient correlation with the photosensitizer accumulation at the currently used drug-light intervals for two chlorine-based drugs. The drug-light intervals aim to maximize the bulk photosensitizer difference between the viable tumour and the surrounding host tissue; however, imaging studies showed that the differential Photosensitizer concentration at the tumour's leading edge is not much different from that in normal tissue. Given the high blood volume and blood flow at the tumour's leading edge, this strongly suggests that either the blood-brain barrier is still limiting extravasation or, in the case of a compromised barrier, the washout phase of the drug has already commenced.