How to personalize PDT treatment: From Dose definition to an actual plan

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Photodynamic Therapy (PDT) is gaining traction through the development of novel photosensitizer and a variet of ongoing clinical trials in oncology. To further advance the benefit of PDT for cancer patients the communications between chemist, pharmacologist and physicist need to be improved. In drug design, chemist aim for photosensitizers with a high singlet oxygen or reactive oxygen species yield as well as high photostability, whereas pharmacologist consider improving targeting to maximize the photosensitizers specific uptake ratio between target and host tissues. However, achieving high therapeutic selectivity requires additional considerations, including the differential photon propagation throughout the treatment volume for different wavelength and also the tissue's capacity to mitigate the effects of the oxygen radicals. Photon propagation can vary significant between patients as well as the PDT responsivity of different tumours.

Based on the Photodynamic Threshold model, dose planning for individual patients will be described as well as avenues to improve PDT selectivity due to adjuvant therapies.
PDT treatment planning requires knowledge of the planning volume's, anatomy, tissue optical properties, photosensitizer accumulation and PDT responsivity to provide the surgeon with the light source locations and their photon emission intensity. Only the patient specific anatomy is know a priori whereas for planning purposes population average values have to employed. Nevertheless the resulting PDT treatment plan needs to be robust for a range of tissue optical properties and photosensitizer tissue selectivity. Technical avenues to obtain the tissue optical properties using fluence rate sensors and predicting the spatial photosensitizer accumulation are introduced as well as Monte Carlo based PDT treatment outcome prediction.

The use of adjuvant therapies to modulate in particular the tissue's PDT responsivity, including tyrosine kinase inhibitor, photobiomodulation and hypothermia will also be introduced.