PhD Thesis Defense MIGUEL MIRELES 'Hybrid diffuse optics for translational oncology and nanobiophotonics: Towards a Theranostic Approach for Emerging Cancer Therapies'

MIGUEL MIRELES

October 24, 2018

Wednesday, October 24, 11:00. ICFO Auditorium

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Medical Optics

ICFO-The Institute of Photonic Sciences

A pre-clinical mouse model of human clear cell renal cell carcinoma (ccRCC) was employed as a method to study the prognostic and theranostic

potential of two, non-invasive, deep tissue, diffuse optical techniques, namely broadband diffuse reflectance spectroscopy (DRS) and diffuse correlation spectroscopy (DCS). In doing so, new algorithms and methods were developed to improve the robustness and applicability of the technology and a vision is presented for its clinical translation.

Hemodynamic biomarkers such as the total hemoglobin concentration (THC), blood oxygen saturation (SO2) and blood flow (BFI) that
were measured in a longitudinal and quantitative fashion from deep tissue layers (> 2 mm) were used to predict the outcome of an antiangiogenic
therapy, Sunitinib therapy. Hemodynamic biomarkers were shown to be useful for treatment planning prior to the onset of the therapy and, at an early stage (few days), as predictors of the therapy outcome.

The second part of this work focused on another emerging class of treatments based on the nanobiophotonics as a complementary tool
for improving other cancer therapies. The specific needs for the optimization of plasmon photo-thermal therapy based on customized
gold nanorods was studied. Based on that, it was hypothesized that the combination of DCS and DRS would enable dose planning and in vivo on-line evaluation of the treatment effects. As a means to reach this goal, this work has shown that DRS/DCS can, estimate the in vivo PEGylated gold nanorod (AuNR-PEG) concentration and detect their
accumulation and clearance from the tissues in a longitudinal manner.
Furthermore, it was shown that the injection of AuNRs-PEG do not alter the tumor hemodynamics and, that, had there been any alterations,
we could monitor its effects.

All these studies were done with a contact probe which was previously validated but was also shown to cause some systematic effects.
A proof-of-concept, scanning, non-contact system was developed and validated as a future tool to overcome these limitations.

Overall, this work contributed to bridge some of the gaps in translational oncology towards the development of personalized cancer therapies.

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