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Magnetic nanoparticle hyperthermia for deep sitting cancer therapy

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Magnetic nano-particle hyperthermia (MNPH) is minimally invasive thermal technique for cancer therapy. One of main characteristics of MNPs for clinical hyperthermia is a high specific absorption rate (SAR), which depends on the applied magnetic field frequency, strength and MNP properties. During MNPH therapy a coil produces alternating electric and magnetic fields. The alternating magnetic field (AMF) penetrates inside tissue and activates MNPs in cancerous tissues, where else the alternating electric field produce undesirable eddy currents within normal tissue. Since, the AMF from a coil decays rapidly (as 1/R2); therefore, to use magnetic hyperthermia for deep tumors, such as pancreatic, prostate, rectum and etc. cancers, a high-magnitude transmitter current is required in the coil. High transmitter currents also produce high electric fields E and eddy currents J within normal tissue that cause non-specific heating (J.E), which limits the applicability of MNP hyperthermia for deep sitting cancers. To overcome this problem, recently we have develop next generation Dartmouth MNP, with high SAR at low AMF strength, and a new device for guiding and delivering transmitted magnetic fields to deep tumors and for minimizing undesirable eddy currents heating in normal tissues. In this presentation, first the system's AMF delivery and focusing performance will be described and illustrated using both modelled and measured data, then temperature distributions in a conducting phantom with and without the flexible magnetic device will be shown, and finally, applicability of the device for clinically MNPH therapy will be demonstrated in combination with the next generation MNP.

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The fundamental questions to be answered with our Biophotonics studies are: How toapproach photodynamic therapy concerning dosimetry and tumor cells selectivity? This aspectshall greatly contribute to the clinical protocols. What must be done to understand the processes related to PDT that determines the amount/volume of tissue that become necrotic? Is photodynamic therapy using two-photon excitation practicable? How should wide-field and fluorescence imaging techniques be combines for better tumor diagnosis? How much influence light should exert into cells metabolic processes so that photonic techniques may contribute to metabolism reorganization? How to deal with melanoma cells intrinsic characteristics to improve its detection and treatment? How to broaden photodynamic approaches for microorganisms? How to design new photosensitizers with more specific action? Moreover, we plan to carry on clinical studies in cancer and tumor optical diagnosis, as well as new clinical protocols for the treatment of lesions and HPV (human papilloma virus) infection, and to develop and implement optical methods for detection of several tissue abnormalities. We are representing one of scientific center in Brazil with know-how in establishment of clinical partnership with several institutions, incorporating new technologies for healthcare sciences.

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