9:30am-10:00am(Invited)
TuA3

Thermal dosimetry in porcine tissue: choice of laser wavelength for LITT

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Laser interstitial thermotherapy (LITT) is a minimally invasive procedure for the treatment of small tumors of the breast. During LITT, heat is produced through the localized absorption of infrared laser radiation by tissue surrounding the treatment site. A fiber probe is used to transmit the light to the tumor site, located stereotactically by radiomammography under the control of the oncologist. Since the goal of the treatment is to induce localized cell death as a result of hyperthermia, the effectiveness of the treatment and a suitable treatment endpoint is observed by the measurement of the resultant temperature distribution in the region of interest. Ongoing studies have examined

i) the thermal and light distribution of LITT treatment as a function of applied laser power and duration
ii) the thermal and light distribution of diffusing light fibers of different designs and geometries
iii) the thermal dosimetry in ex-vivo porcine and human breast tissue, in-vivo porcine tissue and a range of tissue phantoms of controlled or known optical properties
iv) the thermal dosimetry of tissue models as a function of wavelength of candidate treatment lasers.

A previously described experimental approach (Manns et al., 1999) using a thermocouple array grid to measure the resultant thermal field was used to assess the thermal heating characteristics of two near IR diode laser systems applied to porcine tissue. Based on an analysis using the bioheat equation of experimentally acquired data obtained in non-perfusing (ex vivo) porcine tissues, different thermal heating curves were reproducibly observed. Depending upon distance of individual thermocouples from the LITT probe, irradiated tissue temperature time curves were explained by a combination of direct heating, direct heating plus a heat conduction term, and by a heat conduction term only. The effect of the choice of laser wavelength in the near IR region , at 980 and 830 nm, on the desired therapeutic treatment zone is discussed in terms of the thermal and optical properties of target tissues and the applied laser power. The results indicate that experimentally observed heating curves were dependent on the tissue composition (muscle tissue vs. fatty tissue) and were broadly similar to those obtained from a tissue phantom model (Salas et al., 2000) which has adjustable optical properties.

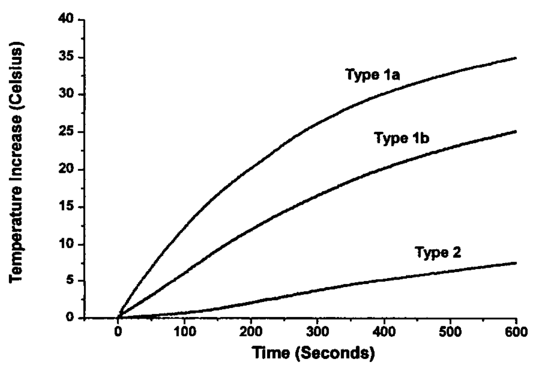

Figure 1. Three types of heating curves observed in ex-vivo porcine mammary chain tissue

References:

Manns, F, P. Milne, N. Salas, N. Pandya, D. Denham, J.M. Parel and D. Robinson (1999), Mathematical analysis of the temperature field during the ex-vivo and in-vivo experimental laser interstitial thermotherapy (LITT) in breast tissue models, SPIE Proceedings, Lasers in Surgery: Advanced Characterization, Therapeutics and Systems IX, **3590**, pp448-454.

Salas, N, F. Manns, P. Chapon, P. Milne, S. Mendoza, D. Denham, J.-M. Parel and D Robinson, (2000), Development of a tissue phantom for experimennal studies on laser interstitial thermotherapy of breast cancer, SPIE Proceedings, Lasers in Surgery: Advanced Characterization, Therapeutics, and Systems X, 3907, pp623-631.