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Oncothermia – Nano-heating paradigm

Oliver Szasz, Andras Szasz
St. István University, Hungary

Abstract

Introduction – There are numerous results showing the significant effects of hyperthermia in oncology. Despite of the advantages, hyperthermia is not yet widely accepted by the medical community. Why is it so? There are multiple sources of the healthy skepticism: the dose (temperature) and treatment protocolsdo not work reliably; no definite reference point exists for comparisonof various applied heating techniques; multiple unwanted hot-spots could be created by the radiation techniques; any proper focus of the incident energy serves as a heat-source heating up its surroundings, risking the promotion of accelerated tumor-growth and dissemination; the artificial focus is not able to follow the natural shapes and the natural movements of the tumor.

Method – Facing the above challenges we applied nano-heating technologyselecting and heating the membrane of the malignant cells purely by the electromagnetic effects without any extra nano-particle applications. The technology (oncothermia [1]) is impedance controlled capacitive coupling; no plane-wave radiation dominates as in other capacitive (radiative) solutions. The method uses strict impedance matching current source of 13.56 MHz carrier frequency with time-fractal modulation. The surface power-density of the signal is limited by the toxic (blistering) limit 0.5 W/cm^2. The nano-selection is based on the metabolic, adherents and organizing differences of the malignant cells. The cell-killing mechanisms are proven in silico, in vitro and in vivo experiments.The efficacy and the active molecular changes are measured immunehistochemically and by protein and DNA arrays.

Results – Strong synergy of the temperature and the applied electric field is proven, which dominantly kills the malignant cells by apoptotic way. The macro- and micro-morphology, the β-catenin nuclear re-localization, the activated early and late apoptotic pathways (Caspase 3; TUNEL) as well as the DNA defragmentation by time show the apoptosis. E-cadherin-β-catenin complex is reconstructed bythe oncothermia treatment. This coupling can contribute to the mechanical integrity and suppresses the metastatic activity. The nano-range energy-liberation could be precisely controlled without considerable wasted energy. The reestablished adherent connections by the nano-manipulation prevents the further dissemination risk and the immune-reactions are active in far-away distances from the treatment localization.The method has extended preclinical and clinical applications.

Conclusion – Oncothermia shows its definite advantages in local cell-killing and in blocking of the metastatic processes too. It is a feasible method for the reliable and controllable basic of the modern hyperthermia demands in oncology [1].

Biography

Szasz O. Bioengineer, associate professor atBiotechnics Department of St. István University (Hungary). He has over 40 published articles, owns patents. He has essential contribution of inventing of nano-heating technology.

Szasz A. Biophysicist, professor at St. István University (Hungary), head of Biotechnics Department, visiting professor at Chiba University (Japan). He has over 300 publications, including a book and chapters, and he is inventor of numerous patents.

biotech@gek.szie.hu