Moderate hyperthermia treatment of tumor through injectable magnetic implants

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Hyperthermia is an effective adjuvant in cancer therapy that combines synergistically with radiotherapy or chemotherapy. Local hyperthermia can be produced through implantation of superparamagnetic nanoparticles (SPIONs) and subsequent excitation by a magnetic field, resulting in a heat dose lethal for tumor cells (Fig. 1). In contrast to magnetic fluid hyperthermia, we entrap the SPIONs in an implant at the tumoral site, avoiding distant migration and allowing for repeated treatment. Mice were submitted to 20 min-hyperthermia under 9 to 12 mT magnetic field, leading to equilibrium cutaneous temperatures of 40 °C to 47 °C. Mean survival was 37 days for 12 mT (47 °C)-treated mice, compared to 12 days for non-treated mice (Fig. 2). Following 12 mT hyperthermia, 45 % of the mice were definitely cured. These data shows the feasibility of implant-mediated hyperthermia.

Future work aims at the development of specific treatments for spine and bone tumors.

One envisioned application is the treatment of deep tumors that are difficult to access. Tumors of the spine, hip or pelvis might be treated though implant hyperthermia. The most advanced application is vertebroplasty, for which a prosthetic functional implant able to fight tumor growth through heating could bring a significant benefit to the patient.

To date, we developed different injectable formulations carrying SPIONs and capable of forming in situ a solid intratumoral implant. One of these formulations was tested on mice grafted with subcutaneous colonic carcinoma.

Sclerosing agents are a complementary therapeutic alternative for tumor treatment. Liquid formulations that form in situ semisolid implants or foams may incorporate compounds such as ethanol or surfactants, inducing vessel wall sclerosis, leading to thrombosis and destruction of diseased tissues. Such agents have already been successfully tested on animal models.

References
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