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Hyperthermia and nanotechnology – A note from the Editor-in-chief

This special issue of the *International Journal of Hyperthermia* focuses on the subject of nanotechnology. Federal initiatives to accelerate research in nanotechnology in the USA in 2001 led to dramatic increases in funding for nanotechnology, coming with the promise that treatment of human disease would be revolutionized. There is no question that the ingenuity of scientists around the world has galvanized around nanotechnology over the past ten years, leading to methods to treat a broad spectrum of diseases [1]. In this issue, we focus on applications related to the use of hyperthermia. Many nanotechnology applications center on hyperthermia. Nanotechnology can be used to heat tumors or to deliver drugs. Special properties of nanotechnologies lend themselves to be imaged as well, permitting the tracking of drug delivery directly. This ability may well prove revolutionary for how we eventually are able to perform drug pharmacodynamics, using imaging data to provide individualized treatments to patients.

The paper by Stephen Barry provides a broad overview of considerations necessary for optimizing magnetic nanoparticle delivery to tumors. Although this paper emphasizes magnetic nanoparticles, many of the general principles apply to nanoparticles of any formulation. He reviews the effects of hyperthermia on liposomal drug delivery and emphasizes how nanoparticles can be imaged and used for hyperthermia generation and drug delivery. The paper by Thiesen and Jordan presents the clinical state-of-the-art for using magnetic nanoparticle applications to heat tumors, as this group has gone the farthest in moving this technology into clinical trials.

In 1994 this *Journal* published the first paper on the subject of liposomal drug delivery augmentation by hyperthermia [2]. Since then several other papers have been published in the *Journal* with subjects ranging from *in vitro* studies of liposome cell interactions and imaging to clinical trials [2–14]. In this issue, Chen et al. report on the influence of differences in vascular permeability on the efficacy of a novel doxorubicin-containing thermally sensitive liposome. This liposome is also in a phase I human clinical trial in women with chest wall recurrences of breast cancer and in a phase III trial of hepatocellular carcinoma in combination with thermal ablation (NIH PDQ NCT00346229 and PDQ CT00617981, respectively). Importantly, other liposomal drug formulations have been used safely in combination with hyperthermia in human patients [10, 15], paving the way for future human trials.

We have included two papers that explore emerging state-of-the-art nanotechnological applications with hyperthermia in new directions. These newer technologies have yet to enter human clinical trials, but hold great promise. MacKay and Chilkoti discuss use of temperature sensitive peptides that undergo inverse phase transition when heated, forcing them to go from a soluble state to aggregates. By alternating hyperthermic pulses with cooling, they show how drug conjugated to these polymers can be thermally pumped into tumors. The same technology was adapted previously for use in non-invasive thermometry [16]. Klingeler et al., discuss how carbon nanotubes, which represent a diverse platform for simultaneously delivering hyperthermia, providing non-invasive thermometry, temperature control and drug delivery.

Finally we have invited a paper from O'Neill and King, who discuss how high intensity focused ultrasound (HIFU) can be used to augment drug delivery from traditional drugs, monoclonal antibodies, naked DNA and liposomes.

The diversity of nanotechnology is well represented in this special issue. We hope that this volume will stimulate submissions to the *International Journal of Hyperthermia* from scientists across the world engaged in this exciting new frontier of medicine.

Mark W. Dewhirst, DVM, PhD
Editor-in-Chief

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