
Thermal Combination Therapies using MR-HIFU

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Abstract

Diagnostic imaging is indispensable in clinical routine for diagnosis and staging of diseases. Over the last years, diagnostic imaging moved also into the therapeutic setting to guide therapeutic interventions. One example is MR-guided high intensity focused ultrasound (HIFU) for thermal ablation of tissue. Here, ultrasound waves are focused through the skin onto any deep-seated tissue where energy dissipation leads to local heating. At temperatures above 55 °C, almost instant thermal necrosis is induced. With a focus volume of dimensions comparable to a grain of rice, this technique is comparable to a thermal knife. MRI is used for therapy planning and subsequently to measure non-invasively the temperature inside the target tissue. Besides the direct thermal destruction of tissue, heating can also be used to trigger a local chemotherapy using heat sensitive nanoparticles. In this approach, chemotherapeutic drugs are stably encapsulated in the water-rich interior lumen of temperature-sensitive nanoparticles at body temperature, but are released at elevated temperatures. Non-invasive heating of a malignant tissue will therefore trigger local drug release, leading to high local concentration of chemotherapy. Co-encapsulation of MR-contrast agents inside the liposomes allows MR-based quantification of drug release while the therapy is ongoing. Ablation and local drug delivery can be combined into one protocol for efficient treatment of cancer. In this talk, an overview will be given on our experience and results using MR-HIFU in oncological applications, especially in combination with nanomedicine approaches based on heat sensitive liposomes. Furthermore, a brief overview of the ongoing MR-HIFU activities at University Hospital of Cologne will be given.