Determination of Thermal Effect of Phototherapy in Cancer Treatment Using Magnetic Resonance Thermometry

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Background and Objective Temperature distribution within biological tissue is a critical factor in photothermal therapy for cancer treatment. The aim of this study was to determine the feasibility of real-time monitoring of tissue temperature distribution during laser treatment of target tissue using Magnetic Resonance Thermometry (MRT).

Methods A near-infrared laser and a light-absorbing dye were used for selective photothermal treatment. A 7.1-Tesla Magnetic Resonance Imager for small animal studies was used for 3-D non-invasive temperature mapping in target tissue. The measurement was conducted using phantom gel and tumor-bearing rats.

Results Using the MRI system and a specially designed processing algorithm, a temperature distribution matrix was obtained during laser irradiation of target tissue. The total system error was less than 0.5°C. The spatial resolution of the MRI measurement was in the range of 0.2-0.4 mm within the biological tissue.

Discussion and Conclusions MRT is shown to be an effective method in determining tissue temperature distribution with high temporal and spatial resolutions. It could potentially be used to monitor and control tissue temperature during laser treatment for optimal photothermal treatment of tumors.

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