

PRESCRIPTIVE, QUANTITATIVE SAR DOSIMETRY FOR CHEST WALL RECURRENCES

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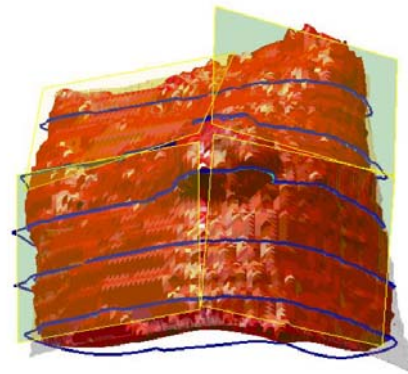
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Purpose: Quality of a hyperthermia treatment is a key factor for treatment outcome. Improvement of hyperthermia treatment quality is severely hampered by the lack of a single prognostic parameter for treatment outcome and our inability to prospectively prescribe the thermal dose. An absolute requirement for future solutions to this problem is that they must be “*economically as well as clinically acceptable*“. Adequate monitoring of hyperthermia treatment quality is a very difficult task. Neither the patient nor the clinician appreciates extensive interstitial thermometry. Non-invasive thermometry has not been demonstrated to provide the required spatial resolution and temperature sensitivity for superficial hyperthermia. Fortunately, the presently available advanced hyperthermia treatment planning systems provide an excellent opportunity to calculate 3D SAR- or temperature distributions and derive predicted HT-dose parameters from these distributions.

Methods: An FDTD simulation package (SEMCAD, Schmid & Partner Engineering AG, Zürich, Switzerland) is used to predict the SAR distribution for a 2x2 array of Lucite cone waveguide applicators. The 3-D model predictions are validated against 3-D measured SAR distributions using the well-accepted gamma-method. In this manner the relative SAR distributions as predicted by the FDTD model are transferred to quantitative SAR distributions providing the possibility to correct for the different efficacy of the four LCA applicators. The feasibility to quantitatively predict the 3-D SAR distribution in a realistic anatomy is demonstrated for a patient with a tumor located on the chest wall. The HT field involves all macro- and microscopic tumor and should cover the whole RT-field.

Results: A good quantitative agreement was found between the measured and predicted 3-D SAR distribution. The 3-D SAR prediction for the patient shows that the umbrella-style array configuration basically represents a “heating the base” approach: the applicators deposit most their EM power at the tissue below their footprint. The iso-surface of about half the maximum SAR value does not cover the center of the tumor.

Conclusions: The result of this explorative study demonstrates that the SEMCAD model provides reliable predictions of the SAR pattern of the LCA and can be used safely to study the performance of the LCA under clinical conditions. The next step of this project is to apply treatment modelling for SHT in a well-defined group of patients to investigate the potential of predicted 3D SAR distribution as source for a dose parameter that is prognostic for treatment outcome.



Simulation of a 2 x 2 array of Lucite Cone applicators: SAR iso-surface for 2.5 W/kg (i.e. 25% iso-SAR contour).