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Numerical Simulation of Heating Characteristics in a Microwave T-Prong Antenna for Cancer Therapy

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Abstract : This research is presented with microwave (MW) ablation by using the T-Prong monopole antennas. In the study, three-dimensional (3D) finite-element methods (FEM) were utilized to analyse: the tissue heat flux, temperature distributions (heating pattern) and volume destruction during MW ablation in liver cancer tissue. The configurations of T-Prong monopole antennas were considered: Three T-prong antenna, Expand T-Prong antenna and Arrow T-Prong antenna. The 3D FEMs solutions were based on Maxwell and bio-heat equations. The microwave power deliveries were 10 W; the duration of ablation in all cases was 300s. Our numerical result, heat flux and the hotspot occurred at the tip of the T-prong antenna for all cases. The temperature distribution pattern of all antennas was teardrop. The Arrow T-Prong antenna can induce the highest temperature within cancer tissue. The microwave ablation was successful when the region where the temperatures exceed 50°C (i.e. complete destruction). The Expand T-Prong antenna could complete destruction the liver cancer tissue was maximized (6.05 cm^3). The ablation pattern or axial ratio (Widest/length) of Expand T-Prong antenna and Arrow T-Prong antenna was 1, but the axial ratio of Three T-prong antenna of about 1.15.

Keywords : liver cancer, T-Prong antenna, finite element, microwave ablation
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