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The Optimization of the Treatment Planning for Achieving Complete Ablation of Human Liver Tumor during Irreversible Electroporation by Genetic Algorithm

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Irreversible electroporation (IRE) is a novel tumor ablation technology. Now it has been used by clinicians for several trials. The clinical trials showed that the effect of the IRE is greatly limited by the inadequate treatment planning. The outcome of IRE depends on the effective electric field distribution in tumors. In order to analyze the effect of real tumor ablation by irreversible electroporation, a three-dimensional model of real liver tumor and liver was established, using CT slice from a patient with liver cancer, and the use of finite element analysis software COMSOL helped build the numerical model of the tumor and normal tissues. The genetic algorithm was used to optimize electrode arrangement and pulse parameters. The irreversible electroporation electric field distribution and effects of tumors and liver ablation were obtained. The simulation results reveal that with the use of the parameters optimized by genetic algorithm, the pulsed electric field can achieve ablation of real tumors, and minimize damage to normal tissues, which indicates the feasibility of genetic algorithm to optimize the irreversible electroporation electric field distribution. With the help of genetic algorithm, this paper successfully optimized and attained electrode arrangement and pulse parameters to ablate real tumors. This will be helpful to make treatment planning in clinical.

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