

Treatment planning system for AC electric field therapy based on absorbed energy

Department of Biomedical Engineering, Korea University, Seoul, Republic of Korea

Geon Oh, Yunhui Jo, Yongha Ki, Heehun Sung, Myonggeun Yoon

Purpose: Tumor Treating Electric Fields (TTF) therapy is cancer therapy that passed FDA in the United States. However, TTF therapy doesn't have the concept of dose commonly used in radiotherapy or chemotherapy, and it can be said to be a treatment that doesn't apply to prescription doses that are applied differently depending on the type or properties of tumor. Also, there is no treatment planning system including the factors related to the therapeutic effect, such as patient tissue density & electrical conductivity, treatment frequency and application time of the electric field. For the above reasons, TTF therapy needs treatment planning system that calculates the physical absorbed energy given to each tissue based on the strength of the electric field, the density & electrical conductivity of tissue, and the time applied to each tissue in the human body. Furthermore, by going through the optimization process using the factors calculated above, it is possible to minimize side effects while maximizing the treatment efficiency of the prescribed dose for patient.

Materials and Methods: The proposed Treatment planning system for AC electric field therapy based on absorbed energy includes five parts: 1) Image classification part for classifying organs and tumors from medical images of patients including organs and tumors; 2) Property information setting part that sets property information of each area classified by the image classification part; 3) Prescription information determination part that sets a prescription method in consideration of input tumor type and tumor state information, and determines prescription information including prescription dose, number of treatments, treatment time, and treatment frequency; 4) Dose calculation part that calculate dose distribution based on initial setting of the number of electrodes used, the position of the electrodes, and the electric field strength for each electrode considering each area classified by the image classification part; 5) Dose optimization part that optimizes the dose so that the prescribed dose is given to the tumor as much as possible and to the surrounding normal tissues by changing at least one of the number of electrodes, the location of the electrodes, and the electric field strength for each electrode.

Results: The treatment planning system calculated the optimal electric field distribution reflecting the various factors related to the actual TTF therapy.

Conclusions: Compared to previous TTF treatments, TTF treatment using the proposed treatment planning system improve calculation of practical treatment factors and treatment effects

<u>Keywords:</u> Treatment plan system for tumor treating electric fields therapy, Absorbed energy, Optimization process
