

Study of the Static and Dynamic Characterization of the Biological Tissue to Obtain the Temperature Estimation in RF Ablation using Computer Modeling

José Alba*, Macarena Trujillo, Ramón Blasco and Enrique J Berjano

Electronic Engineering Department, Biomedical Synergy, Torrent, Valencia, Spain

Radiofrequency ablation has been used to treat some types of cardiac arrhythmias. We have previously proposed an ARMAX model (non structural) to estimate the temperature in the tissue during ablation. Computer modeling has allowed us to study the temperature distribution by means of solving numerically theoretical models based on partial differential equations, which represent physical phenomena. Now our objective is to consider the biological tissue as a system with an input (applied voltage) and output (tissue temperature), and thus to search for a transfer function between these variables. The final aim is to have a simple model that could estimate the temperature at each point of the tissue. We solved the model using the finite element method and identified the transfer function between the temperature at 4 mm depth and an applied voltage using a 7Fr and 4 mm electrode. We used COMSOL Multiphysics to solve the electro-thermal problem and MATLAB to obtain the transfer function. The results showed that the variation in the electrical conductivity of cardiac tissue affected only the static gain of the system, while the variation in the specific heat produced a change only in the dynamic system response. However, the variation in thermal conductivity modified both the static gain and the dynamic system response. These results are a first step towards the development of a macroscopic model based in physical principles, which would lead to better temperature estimation during ablation.