An experimental study on the effect of the anisotropic regions in a realistically shaped torso phantom

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Abstract

Determination of electrically active regions in the human body by observing generated bioelectric and/or biomagnetic signals is known as source reconstruction. In the reconstruction process, it is assumed that the volume conductor consists of isotropic compartments and homogeneous tissue bioelectric parameters but this assumption introduces errors when the tissue of interest is anisotropic. The aim of this study was to investigate changes in the measured signal strengths and the estimated positions and orientations of current dipoles in a realistically shaped torso phantom having a heart region built from single guar gum skeins. Electric data were recorded with 60 electrodes on the front of the chest and 195 sensors measured the magnetic field 2 cm above the chest. The artificial rotating dipoles were located underneath the anisotropic skeins distant from the sensors. It was found that the signal strengths and estimated dipole orientations were influenced by the anisotropy while the estimated dipole positions were not significantly influenced. The signal strength was reduced between 17% and 43% for the different dipole positions when comparing the parallel alignment of dipole orientation and anisotropy direction with the orthogonal alignment. The largest error in the estimation of dipole orientation was 42 degrees. The observed changes in the magnetic fields and electric potentials can be explained by the fact that the anisotropic skeins force the current along its direction. We conclude that taking into account anisotropic structures in the volume conductor might improve signal analysis as well as source strength and orientation estimations for bioelectric and biomagnetic investigations.