How does the dispersive patch affect the efficacy of radiofrequency ablation?

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Radiofrequency ablation (RFA) is a minimally invasive procedure used to treat abnormal electrical signals that cause cardiac arrhythmia. During RFA, the tip electrode of a catheter delivers radiofrequency current at a frequency of 500 kHz. Electrical current flows through the resistive volume, which includes myocardial tissue and blood, and it reaches a dispersive patch positioned on the patient's skin, typically on the back or thigh. We developed a 3D in-silico model based on patient imaging data (as shown in Fig. 1, left). We produced detailed segmentation using 3D Slicer software, encompassing not only the heart but also taking into account surrounding structures such as the lungs, esophagus, and liver. The segmentation consists of 36 uniquely labeled subdomains, each one exhibiting heterogeneous conductivity. Additionally, we discretized the multi-label subdo-

Figure 1: Left: CT scan image with different segments. Right: Torso geometry featuring an embedded catheter using Salome and a dispersive patch at various locations.

mains into an unstructured tetrahedral mesh using Meshtool [1]. We positioned an electrode on the myocardium of the left atrium in proximity to the pulmonary vein (as shown in Fig. 1, right). The electrode has a spherical tip with a radius of 1.165 mm and a length of 3.5 mm. A dispersive patch of dimensions $12 \times 20\,\mathrm{cm}^2$ was placed at various positions on the torso. We solved the quasi-static electrical potential equation to examine the impact of the patch location on both tissue power dissipation and the power dissipation within the entire torso geometry. We also explore the influence of varying patch positions and dimensions on the resulting lesion size.

References

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