Effect of Contact Force Mechanical Deformation on Local Electrical Impedance in Atrial Tissue - an in silico Evaluation

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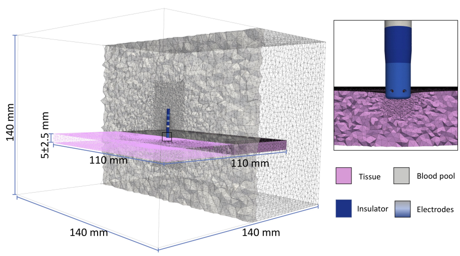
Introduction: Regions with pathologically altered substrate have been identified as potential drivers for atrial fibrillation (AF) maintenance. Recently, local impedance (LI) measurements have gained attention as a voltage surrogate for atrial substrate assessment as it does not rely on electrical activity of the heart. However, an appropriate electrode-tissue contact force (CF) is needed and its effect on the LI measurements in the substrate has not yet been characterized in depth.

Methods: In this study, several CF are applied to a catheter in direct contact with a tissue patch, model as healthy and scar atrial myocardium whose thickness was varied in anatomical ranges, to study the impact of the mechanical deformation on the LI measurements. The model was validated against clinically measured LI at different CF from AF patients.



In silico experiment setup that contains the IntellaNav Stablepoint™ catheter, tissue patch with variable thicknesses, and bloodpool.

Results: Simulation results applying identical CF in healthy and scar tissue yielded lower LI values in scar. Moreover, LI increased in both cases when tissue thickness and CF were increased. When applying CF between 0 and 6 g, in silico LI ranged from 160 Ω to 175 Ω in healthy myocardium, whereas 148 Ω and 151 Ω for scar tissue. Increasing CF in scar tissue up to 25 g, increased LI up to 156 Ω.

Conclusion: Given the results of our study, we conclude that in silico experiments can not only distinguish between healthy and scar tissue by combining CF and LI, but also that our simulation environment faithfully represents clinical LI measurements with and without mechanical deformation in the tissue model.