In-Silico Comparison between In-Vitro and In-Vivo Experimental Setups of Cardiac Radiofrequency Ablation

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Background: Radiofrequency ablation is a standard treatment for cardiac arrhythmia, with experimental studies serving as a cornerstone for procedural refinement. Traditionally, these investigations utilize animal cardiac tissue in either in-vitro or in-vivo settings. While in-vitro models involve isolated tissue segments, in-vivo studies maintain the heart in its physiological state. Because this difference in the experimental setup results in different predicted lesions, we aim to assess this discrepancy between the experimental approaches via an in-silico comparison.

Methods: We performed an in-silico study comparing the in-vitro and in-vivo experimental setups, using a validated computational model from our group [1]. We expanded the model by adjusting the governing equations and boundary conditions to reflect the impact of blood perfusion. We simulated a standard ablation protocol using a modeled catheter, which is in direct contact with the tissue, applying a power of 30 W for 30 s. We compared the effects on lesion volume and temperature.

Results: The distribution of the electric field was different among the two simulated setups. The lesion volume, as depicted in Figure 1, was lower in the in-vitro setup. A higher maximum temperature was observed in the in-vitro simulation.

A.

	In-Vitro	In-Vivo
Volume (mm^3)	150.7	99.7
Temperature (°C)	88.2	81.9

B.

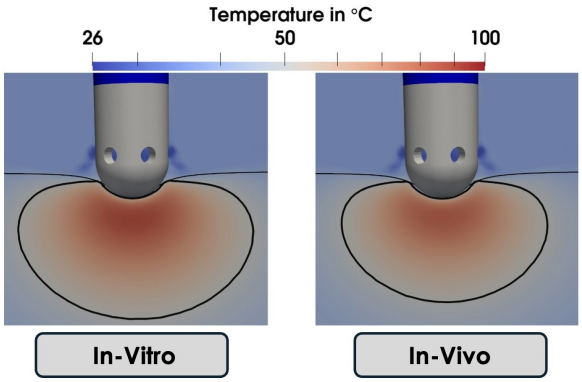

Figure 1: **A.** Table of the numerical results. **B.** Simulated in-vitro (left) and in-vivo (right) experimental setup lesions at $t = 30$ s.

Discussion: Our study shows that the simulated in-vitro setup produces a larger lesion compared to the in-vivo one. This indicates that the lesion quantities obtained from an in-vitro experiment cannot be directly translated to the lesion produced through an in-vivo experiment. Our computational model establishes a framework to quantify these discrepancies.

References:

[1] Leoni, M., Petras, A., Moreno Weidmann Z., Guerra, J.M., Gerardo-Giorda, L., 2023. Should I Tilt or Should I Push? Effect of Contact Force and Catheter Inclination in Cardiac RF Ablation. In *2023 Computing in Cardiology Conference (CinC)*.