Effect of Contact Force on Pulsed Field Ablation Lesions in Porcine Cardiac Tissue

Daniel C. Sigg\textsuperscript{1}, Lars Mattison\textsuperscript{1}, Atul Verma\textsuperscript{2}, Khaldoun G. Tarakji\textsuperscript{1}, Tobias Reichlin\textsuperscript{3}, Gerhard Hindricks\textsuperscript{4}, Kevin Sack L\textsuperscript{1}, Birce Onal\textsuperscript{1}, Megan M. Schmidt\textsuperscript{1}, and Damijan Miklavčič\textsuperscript{5}

\textsuperscript{1}Medtronic Inc
\textsuperscript{2}McGill University
\textsuperscript{3}Inselspital Universitatsspital Bern Universitätsklinik für Kardiologie
\textsuperscript{4}Universität Leipzig Medizinische Fakultät
\textsuperscript{5}University of Ljubljana Ljubljana Slovenia

October 11, 2022

Abstract

\textbf{Background:} Contact force has been used to titrate lesion formation for radiofrequency ablation. Pulsed Field Ablation (PFA) is a field-based ablation technology for which limited evidence on the impact of contact force on lesion size is available.

\textbf{Methods:} Porcine hearts (n=6) were perfused using a modified Langendorff set-up. A prototype focal PFA catheter attached to a force gauge was held perpendicular to the epicardium and lowered until contact was made. Contact force was recorded during each PFA delivery. Matured lesions were cross-sectioned, stained, and the lesion dimensions were measured. Numerical modeling of the catheter-tissue interface under different contact forces was performed to aid in the interpretation of our results and isolate effects of biomechanical tissue displacement.

\textbf{Results:} A total of 82 lesions were evaluated with contact forces between 1.3 g and 48.6 g. Mean lesion depth was 4.8 ± 0.9 mm (standard deviation), mean lesion width was 9.1 ± 1.3 mm and mean lesion volume was 217.0 ± 96.6 mm\textsuperscript{3}. Linear regression curves showed an increase of only 0.01 mm in depth (Depth = 0.01*Contact Force + 4.37, R\textsuperscript{2} = 0.06), 0.03 mm in width (Width = 0.03*Contact Force + 8.32, R\textsuperscript{2} = 0.12) for each additional gram of contact force, and 2.20 mm\textsuperscript{3} in volume (Volume = 2.20*Contact Force + 163, R\textsuperscript{2} = 0.11). Numerical modeling found consistent trends with experimental mean values and shows tissue displacement alone is likely not a significant factor to formation of lesion depth.

\textbf{Conclusions:} Increasing contact force using a bipolar, biphasic focal PFA system has minor effects on acute lesion dimensions in an isolated porcine heart model.

Hosted file