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The Relationship between Impedance Change and Catheter Contact Force During Radiofrequency Ablation: Evaluation in a Porcine Ex Vivo Cardiac Model Using a Novel Force-Sensing Irrigated Tip Ablation Catheter

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Introduction: Irrigation of the ablation electrode decreases thrombus formation during RF ablation, but the optimal power titration strategy to avoid tissue pops/perforation is unknown. The effect of catheter contact force on the safety and efficacy of irrigated RF ablation of cardiac tissue was examined using a novel externally-irrigated catheter with an integrated contact force sensor (TactiCath™, Endosense).

Methods: Freshly-excised hearts from 8 swine were placed in a chamber filled with autologous heparinized blood. Irrigated ablation (17 ml/min) was performed on the LV endocardial surface during superfusion with 3 L/min oxygenated blood (37°C). The coronary arteries were perfused at 125 ml/min. Ablations were performed for 60 sec at 3 contact forces (2, 20 & 60 gm) and 3 power titration strategies - (i) power titration to achieve an ~15 Ω drop, or fixed power at (ii) 20 or (iii) 30 watts.

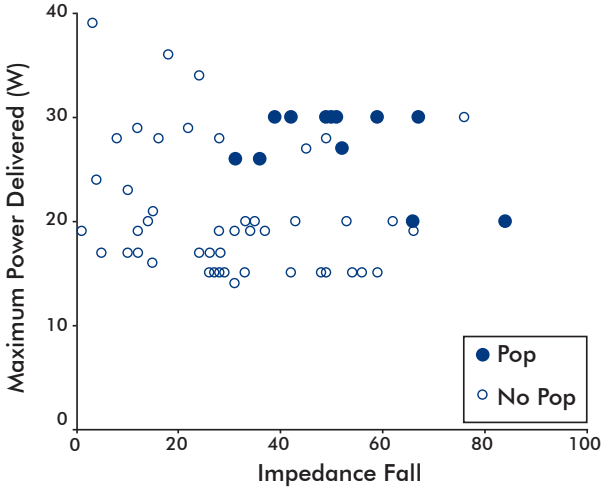
Results: Pops were predicted by large impedance falls and high maximal power (Table & Figure). The impedance change correlated with contact force: 20.6 ± 14.3Ω for 2 gm, 40.7 ± 15.2Ω for 20 gm, and 52 ± 18.6Ω for 60 gm ($p<0.001$).

Conclusions: In this model of irrigated-tip myocardial tissue ablation, high catheter contact force correlates well with popping phenemona. The impedance fall was also a robust indicator of catheter contact force.

Ablation Characteristics by power titration/contact pressure

2 Grams	20 Grams		60 Grams
15 ohms Lesion Depth ..... *Pops* Imp Change	. 5.4±1.5 mm ..... *0%* 17.8±9.0 Ω	. 7.0±1.5 mm ..... 0% 37.8±15.2 Ω	. 7.1±1.5 mm ..... 0% 43.3±13 Ω
20 W Lesion Depth ..... *Pops* Imp Change	. 6.2±1.0 mm ..... *0%* 16.5±14.6 Ω	. 5.9±1.6 mm ..... 0% 35.4±18.2 Ω	. 6.9±1.2 mm ..... 33% 58.8±26.8 Ω
30 W Lesion Depth ..... *Pops* Imp Change	. 6.2±3 mm ..... 11% 25.8±17.6 Ω	. 8.9±1.8 mm ..... 63% 46.7±13.0 Ω	. 8.6±1.7 mm ..... 86% 54.9±13.3 Ω†

† 6 of 7 RF applications were prematurely terminated due to impedance rises.



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