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Force-Time Integral Predicts Lesion Size in Contractile Model Simulating Beating Heart

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Introduction: Catheter contact and RF duration are major determinants of RF ablation lesion size. Since systolic and diastolic forces (F) vary in the beating heart, we evaluated contact force-time integral (FTI) as a predictor of lesion size at constant power in a contractile bench model.

Methods: A motorized platform was used to raise and lower a bovine muscle piece under a perpendicular 4 mm irrigated catheter attached to a force sensor (sensitivity < 1g, 64 Hz sampling rate) with programmable closed loop control to obtain desired contact F. Unipolar RF was delivered at 20 & 40 W (60 s, 17 cc/min irrign) during C: Constant contact (20 g F); V: Variable systolic and diastolic contact (20 & 10 g max & min F) and I: Intermittent contact (20 & 0 g max & min F) with 1-2 mm 'diastolic' loss of contact. V and C were repeated at 2 rates (50 & 100 bpm) and 2 systolic:diastolic ratios (50:50 & 30:70). Measured FTI was correlated with lesion size.

Results: Fourteen (14) lesions were created during C, 48 during V and 35 during I. Measured FTI was highest during C, intermediate during V and lowest during I. At 20 & 40W, lesion depth and volume were greater during C compared to I ($p<0.0001$), during V compared to I ($p<0.0001$) and correlated linearly with FTI ($p<0.0001$)(graph). There were no differences with rate or systolic:diastolic ratio.

Conclusions: During constant power RF ablation, lesion size correlates with contact FTI. Constant contact with the greatest FTI produced the largest and intermittent contact with lowest FTIs produced the smallest lesions. FTI may allow better prediction of lesion size than current parameters.