The Impact of Irrigation Flow Rates on Radiofrequency Ablation Lesions produced by ThermoCool SmartTouch®SF & ThermoCool SmartTouch® catheters in Horizontal & Vertical Orientation

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Introduction: The ThermoCool SmartTouch® catheter (6P) & ThermoCool SmartTouch SF® catheter (56P) are commonly used irrigated catheters with contact force (CF) sensing. Introduced in 2015, 56P catheter was designed to provide uniform surround flow cooling technology and now is the workhorse ablation catheter in several institutions. Prior studies with the 6P platform have suggested that irrigation flow rate (IFR) can impact radiofrequency ablation (RFA) lesion sizes. The comparison of the two catheters on lesion characteristics with interactions of varying IFRs, CFs & catheter orientation has not been reported.

Methods: RFA lesions were created in strips of chicken muscle in a saline bath heated to 37°C with a 56P & 6P catheters using low flow rate (LFR) irrigation at 2cc/min for 56P & 6P and standard flow rate (SFR) at 8cc/min for 56P & 17cc/min for 6P with catheter in horizontal (HO) & vertical (VO) orientations. Ablation power of 20W was delivered for 30 seconds with a CF of 5, 10, 15 and 20 g. When coagulum or a steam-pop occurred, RFA was terminated & repeated at the different site under the same experimental settings.

Result: A total of 176 lesions were analyzed using the 6P and 56P catheter. No lesions with coagulum or steam-pop were included in the analysis. For 56P & 6P catheters in HO & VO for power of 20W and studied CFs, lesion surface areas were significantly higher with LFR compared to SFR (p-values were 0.0001 & 0.0033, respectively). For 6P catheter, LFR resulted in a significant increase of lesion volume compared to SFR (p=0.0078). With comparison of 56P and 6P under the same experimental settings, for studied IFRs, 6P created a deeper lesion with smaller surface areas (LFR: 0.0008 & 0.001, SFR: 0.0015 & 0.0001, respectively). SFR resulted in lesions of a larger volume for 56P compared to 6P (p=0.0008).

Conclusion: For 56P and 6P catheters LFR created shallower with larger surface areas lesions likely from effective ionic shunting. For similar IFR & power setting among studied CFs, 56P irrigated catheter led to shallower lesions with greater surface area compared to 6P irrigated catheter. Increasing endocardial surface lesions without increasing depth is an attractive option in the thin walled posterior left atrium where collateral injury to the esophagus is a feared complication. However, deeper lesions would be advantageous in the ventricle to ensure transmurality. Therefore, the biophysics of lesion creation and the modulation of parameters is important to recognize for the different catheter platforms.