More efficacy and safety of bipolar catheter ablation than unipolar ablation in ventricular myocardium

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Introduction: Bipolar ablation has been used successfully for catheter ablation of arrhythmias refractory to conventional unipolar ablation. However, there is no commercially available equipment for bipolar ablation and limited data exists about the optimal configuration.

Methods: Isolated ventricular septum (VS) and left ventricular free walls (FW) from freshly harvested adult porcine hearts were suspended in a Hartmann’s solution bath warmed to 37 ℃. A customized radiofrequency energy generator was developed to perform bipolar ablation. Lesions were created by sequential unipolar (UNI) and bipolar (BI) ablation using contact-forcing sensing catheters (fixed at 20g) in multiple combinations. (power varied from 20W to 40W; 4mm irrigated versus 8mm tipped catheters as the return electrode; active electrode on epicardium versus endocardial surfaces) Maximum power delivered, impedance, tissue and catheter tip temperatures, lesion dimensions, transmurality and the occurrences of steam pops were recorded.

Result: 275 lesions from 9 pig hearts (mean weight of 506 ± 111 g) were analysed. On the FW, BI resulted in narrower and smaller lesions compared to UNI (p<0.01) but a higher proportion of BI lesions were transmural. UNI created more steam pops (30W - 86.2% vs 46.2%, p<0.01). Lesion volume was larger when the active catheter during BI was placed on the epicardial surface (429.2 ± 148.9 vs 334.5 ± 156.3 mm3, p = 0.04). Increasing power from 20W to 40W resulted in stepwise increases in lesion volume, lesion depth and transmurality, at the expense of more steam pops. Similar findings were replicated on the IVS. The 8mm tip ground electrode resulted in larger lesion volume compared to 4mm irrigated tip (365 ± 143.9 vs 300.1 ± 111.0 mm3, p=0.04). Temperatures up to 80℃ were recorded on the ground electrode during BI.

Conclusion: BI increases the ability to target deep myocardial targets, with a lower risk of steam pops.