Baseline Impedance and Impedance Drop are Good Surrogate Markers for Electrode-Tissue Contact and Contiguous Lesion Formation with a Novel Irrigated Radiofrequency Balloon Catheter

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Introduction: Continuous, circumferential, transmural lesions are desired to facilitate pulmonary vein isolation (PVI). Real-time indicators of adequate lesion creation with ablation are needed, to improve the durability of ablation lesions and prevent recurrence. The purpose of the study was to examine the relationship between ablation electrode impedance (baseline and decrease of impedance during ablation), electrode-tissue contact and RF lesion size using a novel irrigated radiofrequency balloon catheter in the canine thigh muscle preparation.

Methods: In 15 dogs, the skin over the thigh muscle was incised and raised to form a cradle which was superfused with heparinized blood at 37°C. A 10F ablation catheter (Biosense Webster, Inc) with a 28mm balloon, containing a central lumen for external saline irrigation and 10 flexible gold electrodes (each: 14.5 mm x 3 mm with 4 irrigation holes and a thermocouple) surrounding the balloon surface (3mm spacing, Figure) was held against the thigh muscle with a contact force of 20 grams, with full (n=24) or partial contact (n=22) of electrodes. RF (15W per electrode) was delivered for 15, 30 or 60 sec (electrode temperature < 65°C) between 2 adjacent electrodes and a skin patch with saline irrigation at 35ml/min in low blood flow (<0.1m/sec) to favor thrombus formation. The baseline impedance and impedance drop were recorded and compared between full and partial electrode contact ablations.

Result: There was a significant difference in the baseline impedance (mean 83±1.3Ω vs. 71±1.3Ω, p<0.01) and impedance drop (mean 18±0.9Ω vs. 13±0.8Ω, p<0.01) between electrodes with full contact vs. electrodes with partial contact. For ablations with electrodes in full contact with tissue, there was a significant difference in the impedance drop (mean 20±0.9Ω vs. 14±0.4Ω, p<0.05) observed in lesions with no gap (contiguous lesions) compared to lesions with gap. For ablations with electrodes in partial contact with tissue, there was no significant difference in impedance drop between contiguous lesions and lesions with gap (mean 12±0.8Ω vs. 11.6±0.8Ω, p=NS).

Conclusion: Baseline impedance provides a good indication of amount of electrode-tissue contact (full or partial). During ablation, impedance drop provides a good indication of contiguous lesion formation when simultaneously abrating from adjacent electrodes.