

Characterization of Esophageal Temperature Responses to Catheter Based CryoBalloon Ablation of Pulmonary Veins in Dogs

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Background: Cryoballoon ablation has been developed as an alternative technique to RF ablation to achieve pulmonary vein isolation (PVI). The impact of cryoablation of the PV on the esophagus, however, is unknown.

Methods: Internal and external esophageal tissue temperature responses were measured during cryoballoon ablation of the PV's using T-Type thermocouples in 11 dogs in the Mayo Translational EP Lab. Ablation was performed for 4-8 minutes to balloon temperatures of -60 to -80 °C.

Results: 27 cryoballoon ablations were completed, including in 13 LIPV, 5 RIPV, and 9 LSPVs. External esophageal temperatures were <0 °C during 4/13 LIPV, 5/5 RIPV, and 0/9 LSPV freezes. The external esophageal temperatures during ablations ranged from -37 to -15.2 (-26.2 ± 11.2) °C with RIPV; -28.1 to 34.7 (20.1 ± 18.9) °C with LIPV; and 34 to 37 (35.1 ± 1.6) °C with LSPV ablations. For the 9 ablations with external esophageal temperatures from -4.7 to -37 °C (-21.1 ± 13.1) the minimum internal esophageal temperature was 19 to 34 °C (28.7 ± 6.7 °C), $p < 0.0001$, demonstrating a significant gradient. A characteristic intraesophageal temperature profile is shown below. Continued internal esophageal cooling and a protracted thaw phase was seen after ablation termination. Nevertheless, no disruptive injury was seen on gross pathology. Temperatures achieved were all highly distance dependent.

Conclusion: Cryoballoon ablation results in subzero temperatures at the external esophageal surface. Nevertheless, only minimal full thickness cooling and no tissue disruption occurs. Internal esophageal temperature monitoring underestimates the true cooling of the esophagus during cryoballoon ablation.

American Heart Association Scientific Sessions in Chicago, IL. Nov 12-15, 2006