Abstracts

A Method for the In Vitro Testing of Cardiac Ablation Catheters

S.S. Hsu, L. Hoh, R.M. Rosenbaum, A. Rosen, P. Walinsky and A.J. Greenspon. "A Method for the In Vitro Testing of Cardiac Ablation Catheters." 1996 Transactions on Microwave Theory and Techniques 44.10 (Oct. 1996, Part II [T-MTT] (Special Issue on Medical Application and Biological Effects of RF/Microwaves)): 1841-1847.

We have developed a flow-phantom model in order to measure the temperature profile of radio frequency (RF) and microwave (MW) catheters. The model consists of a muscle equivalent phantom in a perfusion chamber with constant saline infusion of 4 L/miu immersed in a 37° C saline bath. RF (4 or 8 mm, 550 kHz) or MW (12 mm helical antenua, 915 MHz) catheters were placed on the surface of the phantom and various energies were applied. Temperature measurements were obtained with fiberoptic thermometry probes placed at various distances from the catheter. Temperature contours were generated, and lesion volumes were estimated using 47° C isotherm (DeltaT >= 10°C). The dosimetry of power versus DeltaT was linear. A 2.59 fold increase in power density was required to achieve a similar surface temperature with the 8 mm versus 4 mm electrode tip. The volumes of lesions created with an 8 mm electrode were 2.5x larger than those made with a 4 mm electrode at a similar surface temperature. The RF phantom data compared favorably with the lesion volumes seen in the in vivo canine left ventricular model. The temperature profile of the microwave electrode showed heating along the length of the catheter due to imperfect tuning of the antenna. Deeper heating was seen with 8 mm RF and MW electrodes than with an RF 4 mm electrode given the same surface temperature. Measurements obtained with both a static and flow-phantom model demonstrated the cooling effects of flow on surface temperature measured during power delivery. Conclusions: The flow-phantom model accurately predicts the lesion geometry but underestimates the lesion volume at higher temperature when compared to the in vivo left ventricular canine model. Static phantom models will overestimate lesion size due to the surface cooling effects of cardiac blood flow. Changes in microwave catheter design may be carefully analyzed with the flow-phantom model prior to in vivo testing.

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