ABSTRACT CA-527: Building a Better Lesion: Investigations into Radiofrequency and Pulsed Field Ablation Biophysics

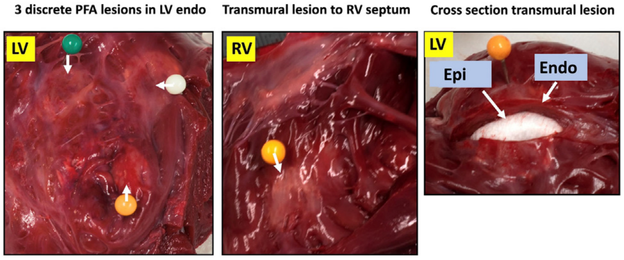
Friday, April 29, 2022
8:00 AM - 9:00 AM

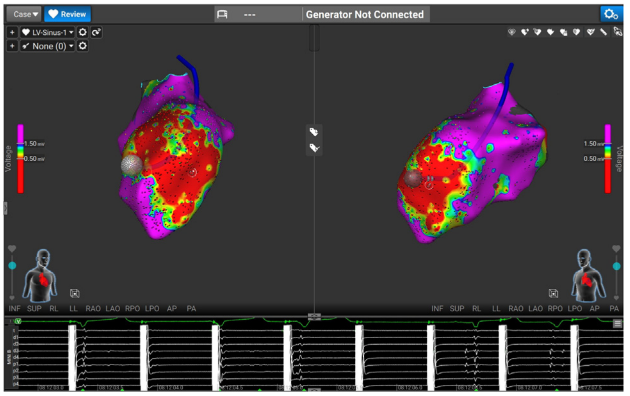
CA-527-01

THE EFFECT OF PULSED FIELD ELECTROPORATION ON VENTRICULAR SCAR IN PRE-CLINICAL MODEL OF MYOCARDIAL INFARCTION

Arwa Younis MD; Israel Zilberman DVM; Koji Higuchi MD; Hagai Yavin MD and Elad Anter MD

Background: Pulsed-field ablation (PFA) is a rapid and nonthermal energy with higher selectivity to myocardial tissue in comparison to radiofrequency ablation. While it produces well-demarcated lesions in healthy ventricles, its effect on clinically relevant scarred myocardium has not been well studied.
Objective: To examine the effect PFA on heterogenous ventricular scar in a preclinical model of healed myocardial infarction.
Methods: In 4 swine, myocardial infarction was created by balloon occlusion of the left anterior descending artery. After a survival period of 8-10 weeks, the LV endocardium was mapped using an 8F bidirectional deflectable catheter with an expandable conductive lattice electrode (Sphere-9™, Affera Inc.) and a compatible electroaantomical mapping system as shown in Figure 1. PFA (biphasic waveform of ±1.3-2.0 kV) was delivered at infarct border-zone sites identified by reduced bipolar voltage (<1.5mV) and abnormal electrograms (Fractionated near field potentials). Tissue capture during pacing (10mV/2msec) was examined before and after ablation at each site. Animals were survived for an additional 48 hours before histopathological analysis.
Results: A total of 11 focal PFA applications were delivered in infarct border-zone sites (2-3 per heart). PFA resulted in elimination of near-field potentials and loss of tissue capture with pacing. In infarct border-zones comprising of viable islands of myocardium separated by collagen, fat, and calcium deposition, PFA produced well-demarcated lesions (Figure 2). Lesion width was 16.5±1.8, lesion depth was 6.6±1.5, and 72.8% of all lesions were transmural. Importantly, PFA successfully ablated viable myocardium both within the infarct and epicardial to the infarct, affecting viable myocardium separated from the energy source by scar tissue.
Conclusion: In a pre-clinical model of healed myocardial infarction, PFA produced well-demarcated lesions that successfully eliminated viable myocardium both within and epicardial to the infarct. PFA may be a promising energy source for rapid ablation of ventricular myocardium to treat scar based ventricular tachycardias.





CA-527-02

LESION CHARACTERISTICS WITH HIGH POWER SHORT DURATION AND CONVENTIONAL RADIOFREQUENCY ABLATION WITHOUT TEMPERATURE CONTROL

Maria Terricabras MD; Grace Huang; Joy Sumin Park; Eduardo Javier Sanhueza Gonzalez MD; Paula Sanchez Somonte MD; Graham Wright MASC, PhD and Atul Verma MD, FHRS

Background: During radiofrequency (RF) ablation, resistive heating causes superficial heating and conductive heating (time dependent) extends to deeper layers. High power short duration (HPSD) ablation should result in wider but shallower lesions by reducing conductive heating. However, if HPSD is delivered with standard ablation catheters, the impact of irrigation rate is not clear.
Objective: Assess the effect of different irrigation rates on lesion formation, geometry and volume using HPSD ablation compared with conventional ablation.
Methods: This study used an ex-vivo model consisting of a circulating saline bath (37°C), an indifferent electrode, a submersible cell load, porcine heart preparations, an Ampere generator and a Flexability ablation catheter (Abbott, Minneapolis, MN, USA). For HPSD, applications were delivered at a power of 70W for 7 seconds maintaining 10-20g of force. Conventional RF was 30W for 30 seconds (10-20g). Irrigation was set at 6ml/min, 10ml/min, 15ml/min, 20ml/min and 30ml/min. Ten lesions were created at each of the five different irrigation settings using the two modalities. The tissue was stained with Triphenyl tetrazolium chloride (TTC) and a digital precision caliper was used to measure every lesion.
Results: Irrigation rate did not change the lesion depth using HPSD or conventional ablation ($p=0.3$; $p=0.2$ respectively). However, lesion width decreased with higher irrigation rates ($p<0.001$). Consequently, lesion volume was also lower ($p=0.008$) at higher irrigation. These findings were not seen using conventional ablation where there was no significant impact on the lesion volume ($p=0.1$).Lesions using HPSD were shallower (3.2±0.6mm vs 4.9±0.8mm; p<0,001) and had smaller volume (80±29mm vs 202±83mm; p<0,001) vs conventional. Lesion shape was different: conventional ablation showed maximum width in the sub-endocardium and HPSD on the endocardial surface.
Conclusion: Higher irrigation rate does not result in deeper lesions but has a direct impact on the lesion width and volume using HPSD. There is no benefit from using high irrigation rates in HPSD ablation performed with non-temperature-controlled catheters.