Background: There is limited data on use of pulsed field ablation (PFA) in the left ventricle (LV), particularly in the presence of myocardial scar

Objective: To evaluate the lesion characteristics of PFA and radiofrequency energy (RFA) in healthy and infarcted LV myocardium

Methods: 10 swine were included: 8 underwent 120min LAD balloon occlusion myocardial infarction and were survived for 6-8 weeks; 2 were healthy controls. PFA and standard RFA was delivered to the LV endocardium in healthy myocardium or scar identified with electroanatomic mapping. Bipolar, biphasic PFA was delivered at 1800 to 2000V for 2.5sec x 4 applications/site using 2 different catheters: linear quadripolar (LINEAR) or multi-spline 8-pole catheter (BASKET). Irrigated RF energy was delivered from 35W-50W to achieve >10 ohm impedance drop. Detailed histologic measurements of ablation depth were performed.

Results: In the PFA group, 21 lesions were delivered to healthy LV and 20 to scar, all without complications. There was no significant difference in histologic lesion depth in healthy myocardium or scar between LINEAR vs. BASKET PFA catheters (Figure A). In the RF group, 19 lesions were delivered to healthy LV and 8 to scar. Maximal lesion depth for PFA and RFA were similar in healthy tissue, however lesion depth was greater for PFA than RFA in scar (Figure B, 6.1±1.7 vs 3.8±1.7 mm; P=0.005). There was no vascular injury observed with PFA, however RFA led to adventitial edema and thrombosis.

Conclusion: PFA allows rapid, safe and effective ablation of surviving islands of myocardium within infarcted LV substrate. Lesion depth in myocardial scar is greater for PFA than RFA. This technology holds promise for treating infarct-related ventricular tachycardia in humans.

CA-534-02

A NOVEL SINGLE-SHOT PULSED FIELD ABLATION SYSTEM IS ASSOCIATED WITH LARGE AND DURABLE VENTRICULAR LESIONS IN VIVO: A PRECLINICAL ASSESSMENT OF SAFETY AND EFFICACY

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Background: Pulsed field ablation (PFA) is a non-thermal ablative strategy that achieves cell death via electroporation.

Objective: We investigated the preclinical safety and efficacy of PFA using 3 novel PFA/mapping catheters (CRC EP Inc, San Jose, CA).

Methods: In total, 14 pulsed field applications were delivered in 5 swine under general anesthesia without paralytic agents, including: 7 lesions in the RV and 7 in the LV. The PFA catheter designs consisted of an 8-Fr, 16-electrode, bidirectional, 25-, 30- or 35-mm spiral. The 2 larger catheters had 2 distal mapping electrode pairs. The catheters were inserted through 8.5-Fr steerable introducers. Bipolar PFA (2.5-4.0 kV) was performed using single-shot, QRS-gated applications under intracardiac echocardiographic guidance. The intensity of skeletal muscle activation was quantified using an accelerometer (Phyphox, Aachen, Germany). Lesions were assessed by pre- versus post-EGM analysis, pacing threshold, 3D voltage mapping (EnSite, Abbott, Chicago, IL), necropsy, and histology. The swine rete mirabile and the kidneys were examined to investigate for embolic events related to PFA.

Results: All applications were single-shot (56 ± 18 s) without repositioning the catheter. Minimal microbubble was observed with no skeletal muscle stimulation - acceleration <0.5 m/s² (noise level). No tachyarrhythmias were induced during PFA. There was marked reduction in post-versus pre-PFA EGMs (0.5 ± 0.2 mV versus 2.0 ± 0.9 mV, P<0.001) and increase in pacing threshold (>20 mA versus 7.5 ± 2.9 mA, P<0.001). All lesions were large and durable up to 28 days of follow-up. The lesions measured: 32.1 ± 4.7 mm (length), 26.6 ± 7.8 mm (width), 8.4 ± 3.1 mm (depth), 62.9 ± 2.1 mm (circumference) and 10.5 ± 3.7 cm³ (volume). Despite the higher waveform voltage and prolonged applications used, no significant thermal effects were detected at necropsy or histology. Moreover, gross and microscopic examinations of the rete mirabile and the kidneys revealed no evidence of thromboembolism in any of the animals.

Conclusion: A novel PFA catheter system can create large and durable ventricular lesions using single-shot, 56-sec applications in vivo. Despite the presence of minimal microbubbles, examination of the rete mirabile and the kidneys revealed no thromboembolic events in any of the animals.

CA-534-03

INVESTIGATING PULSED FIELD (PFA) VS RADIOFREQUENCY ABLATION (RFA) LESION CHARACTERISTICS IN AN IN VIVO HEALTHY PORCINE LEFT VENTRICLE (LV) USING 3D LGE AND NATIVE T1W MAGNETIC RESONANCE IMAGING (MRI)

Terenz Escartin; Maria Terricabras MD; Philippa R.P. Krahn PhD; Jennifer Barry; Melissa Larsen; Nicolas Coulombe MS; Lars M. Mattison PhD; Bor Kos; Matej Kranjc; Jemnej Stublar; Daniel Sigg MD, PhD; Mark T. Stewart BSME; Damijan Miklavcic PhD; Atul Verma MD, FHRS and Graham Wright MASC, PhD

Background: PFA is an emerging largely non-thermal method of ablation. Recently, it was shown in an in vivo porcine model that increasing the number of trains resulted in larger PFA lesions. However, it remains unclear how PFA lesions mature over time.

Objective: Use native T1-weighted (T1w) and 3D late gadolinium enhancement (LGE) MRI to investigate temporal changes in PFA lesion characteristics in an in vivo healthy porcine LV in comparison to RFA lesions.

Methods: PFA was performed in 8 swine via an 8F, 5mm tip focal catheter setup and R-wave gated bipolar pulse trains of 1500 V (1, 4, 8, and 16 trains). N=6 lesions for each bipolar pulsed train number were analyzed. Native T1w and 3D LGE (Gadovist, 0.2 mmol/kg) were acquired at 24 hours (acute), 1 week (subacute) and 6-7 weeks (chronic) post-ablation. RFA was performed in 2 swine using a 3.5 mm tip catheter (SF Thermcool) with MRI acquired at similar timepoints. PFA lesion depths were measured as the max straight-line distance starting from the endocardium using short-axis 3D LGE images.

Results: Native T1w showed no hyperintensity at the PFA lesion locations suggesting the absence of lethal thermal effects, which are easily observed with RFA (Fig. 1). LGE indicated microvascular obstruction (MVO) in 2/24 PFA lesions at 24 hrs only at the highest dosing, while MVO is common in RFA. LGE also indicated regions of increased gadolinium distribution with PFA at 24 hrs that diminished at 1-week. More generally, PFA lesion depth increased with number of trains and decreased as...
the lesions matured over time (Fig. 2). No significant difference in mean PFA lesion depth between 1 week and 6 weeks suggests lesion stabilization.  

**Conclusion:** MRI demonstrates significantly different tissue responses to PFA when compared to RFA, with implications for PFA protocol and associated MRI monitoring optimization.  

**References:**

**Methods:** During a series of endocardial and epicardial dose-finding evaluations, 2 kV bipolar/biphasic PFA pulses were delivered using an 8 Fr focal catheter (Farapoint, Boston Scientific). To evaluate vasospasm, we performed coronary angiography (CAG) after purposefully delivering PF in close proximity to epicardial coronary arteries. After sub-xyphoid pericardial access, the catheter was positioned immediately adjacent to the left anterior descending artery (LAD) in one swine. In two other swine, the catheter was positioned endocardially, immediately above the right coronary artery (RCA) at the proximal cavotricuspid isthmus in one swine and in the pulmonary artery trunk near the LAD in the other swine.  

**Results:** In the swine with epicardial PFA, immediately after the ablation pulses, ST-elevation in the precordial leads was observed. Repeat CAG revealed spasm along the length of the catheter-tip. The spasm gradually recovered over 50 minutes and the animal was successfully survived. In the other 2 swine with endocardial PFA, no ST-changes were observed for either applications. However, CAG demonstrated coronary spasm of the RCA, but not in the LAD. Resolution of RCA spasm was not documented by repeat CAG. These swine was also successfully survived.  

**Conclusion:** Coronary spasm can occur when PFA is performed in close proximity to large epicardial vessels in swine. Further detailed assessments in different animal models are needed to understand its incidence, dependence on proximity and location as well as therapeutic approaches.

**Abstract BS-526:**
Extrinsic factors and mechanisms contributing to cardiac arrhythmias  

**Sunday, May 1, 2022**  
8:00 AM - 9:00 AM  

**BS-526-01**  
THE EFFECT OF CHRONIC NICOTINE EXPOSURE ON CARDIAC ELECTROPHYSIOLOGY IN THE RABBIT HEART