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BIPOLAR PULSED ELECTRIC FIELD ABLATION OF THE INTERVENTRICULAR SEPTUM

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Background: Ablation of deep septal substrate with thermal energy sources conveys many challenges including inadequate lesion depth, inadvertent steam pops, and conduction system injury.
Objective: Pulsed electric fields (PEF) were delivered across the interventricular septum as a preclinical proof-of-concept for transmural ablation through irreversible electroporation.
Methods: In 8 healthy canine 4-week survival experiments, microsecond (n=2; 75-189J/animal) or nanosecond (n=6; 107-275J/animal) duration PEF were applied in a bipolar fashion between solid-tip ablation catheters positioned on either side of the septum in 2-5 separate locations. Radiofrequency (RF) control lesions were delivered for comparison at non-septal sites.
Results: Nanosecond PEF did not result in sustained ventricular tachyarrhythmias or skeletal muscle stimulation as opposed to microsecond PEF. Transient complete heart block was seen in 4 after delivery at the basal septum. Of these, bundle branch block persisted in 3 animals. Two animals died due to intractable VF during the initial experiment: 1 during microsecond delivery and another during an RF lesion. At 4 weeks of survival, 36 individual well-demarcated ablation lesions were demonstrated on both sides of the septum by cardiac MRI, necropsy, and histology. Lesion depth measured by histology was 2.62±2.06 mm with a maximum of 10.9 mm and transmurality in 1 animal.
Conclusion: Bipolar irreversible electroporation of the interventricular septum is feasible and can result in transmural septal ablation lesions. Conduction system injury may occur at least transiently and further refinement is required to improve safety.

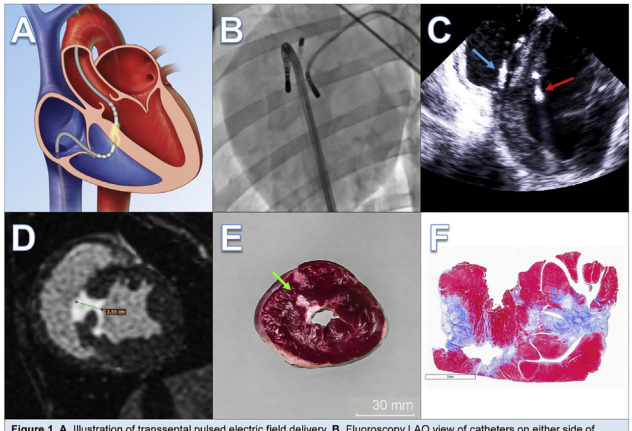

Figure 1. A. Illustration of transseptal pulsed electric field delivery. **B.** Fluoroscopy LAO view of catheters on either side of basal interventricular septum. **C.** Simultaneous intracardiac echocardiography demonstrating catheter position in right ventricle (*blue arrow*) and left ventricle (*red arrow*). **D.** Transmural delayed myocardial gadolinium enhancement on cardiac magnetic resonance imaging at 4 weeks. **E.** Necropsy specimen showing dense pale septal lesion (*green arrow*). **F.** Masson trichome histology demonstrating well demarcated ablation (*blue*) within normal myocardium (*pink*).

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CONVENTIONAL ABLATION WITH HALF NORMAL SALINE IS EQUIVALENT TO HIGH POWER SHORT DURATION ABLATION WITH NORMAL SALINE

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Background: The use of normal saline (NS) with radiofrequency ablation has been shown to increase the depth of the lesion. However, NS contains sufficiently high solute (0.9% of sodium chloride) that its conductive properties dissipate RF energy away from the catheter-tissue interface to the surrounding blood pool. Lowering the ionic concentration of the solution by using half normal saline (HNS) (0.45% of sodium chloride) increases tissue-catheter impedance and lowers solute conductivity; therefore, it results in more energy being delivered to the tissue with less dispersed to the blood.
Objective: To determine whether lesion depth and width using conventional radiofrequency ablation parameters and half normal saline irrigation could be comparable to high power short duration ablation using normal saline.
Methods: This study was performed with 4 Yorkshire pigs (weight 54 +/- 4kg). Using a 3.5mm open tip irrigated ablation catheter 6 lesions were delivered, 8mm apart, for a total duration of 10 seconds in the anterior right atrium (RA) lateral wall. A lesion was delivered only if the contact force was within the range of 10-30 grams. If the solution being used was NS, the power was set at 50W and if it was HNS, the power was set at 35W. The rate of irrigation of both solutions was 30cc/min. Following completion of 6 lesions, the solution was replaced and a second series of 6 lesions was delivered in a more posterior lateral location.
Results: A total of 48 lesions were delivered. The mean contact force delivered using HNS was 18 +/- 4 G and for NS was 16 +/- 6 G (p= 0.26). The median lesion depth for those with conventional power and HNS was 2.1 (IQR 1.8-2.3)mm. For lesions with higher power and NS, the depth was 2.2 (IQR 1.9-2.5)mm (p = 0.12). Lesion width was 4.1 (IQR 3.8 - 4.3) mm for conventional power with HNS versus 4.2 (IQR 3.9-4.4) mm for higher power with NS (p=0.14).
Conclusion: The use of HNS at a lower power setting results in similar lesion dimension compared to NS with higher power when radiofrequency is applied for 10 seconds. Further research is required to evaluate the role of HNS in the atrial ablations.

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EFFICACY OF ESTROGEN SUPPLEMENT ON VENTRICULAR SUBSTRATE IN A RABBIT MODEL OF MENOPAUSE

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Background: Sympathetic hyperactivity in menopausal subjects may lead to autonomic dysfunction and arrhythmic vulnerability. Estrogen supplement has beneficial effects on the cardiovascular diseases, however, the efficacy of hormone therapy is questionable.
Objective: We aimed to evaluate the efficacy of estrogen supplements in the myocardial substrates of menopausal rabbits with ovariectomy (OVX).
Methods: Eight-teen New Zealand female rabbits were randomized into control (n=6), OVX (n=6), and OVX-Estrogen (OVX-E) group (n=6). The menopause model was done by bilateral OVX. All rabbits received blood samples, EP studies, and VT inducibility tests (Max output with shortest 1:1 cycle length pacing) with a high-density contact multielectrode mapping after induction of sustained VT. Myocardium was harvest for Trichrome and tyrosine stain.