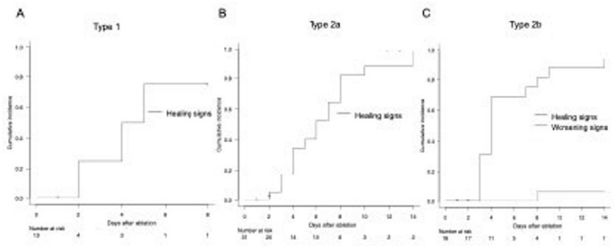
atrioesophageal fistula, AEF). Repeated EGD was performed within 1-14 days after the first EGD until healing signs were observed.
Results: Esophageal lesions were detected by initial EGD in 62 patients (mean age; 64.2 ± 13.0, female; 43.5%, 21%; type 1, 50%; type 2a, 29%; type 2b) and 43 patients underwent repeated EGDs. In these 43 patients, all lesions showed healing signs in repeated EGD within 14 days after ablation but one type 2b lesion which showed enlarging injury in repeated EGD and finally developed into an AEF.
Conclusion: We showed that all ETIs which did not progress to AEF showed signs of healing in repeated EGD within 14 days after the procedure. Worsening ETI diagnosed by repeated EGD may be a sign for developing esophageal perforation and provide the basis for more aggressive treatment strategy to lower risk of AEF.



Cumulative incidence of healing and worsening signs of esophageal injury in follow-up EGD based on the severity of esophageal injury with panel (A) for Type 1, panel (B) for Type 2a and panel (C) for Type 2b. Type 2b was the most serious injury seen in our cohort. Black curve represents cumulative incidence of patients who represented healing signs in follow-up EGD, and the red represents that of patients who represented worsening signs, respectively. The event of worsening signs was treated as a competing event of healing signs. Vertical tick marks indicate right-censored patients.

CA-528-03

A REGISTRY REVIEW UPDATE OF 7120 CATHETER ABLATIONS FOR ATRIAL FIBRILLATION USING A DEDICATED ESOPHAGEAL TEMPERATURE CONTROL DEVICE FOR PROTECTION

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Background: Esophageal protection using a dedicated device to provide controlled active thermal protection of the esophagus during atrial fibrillation ablation has been shown to be effective. Randomized evidence from the IMPACT trial showed an 83.4% reduction in endoscopically detected esophageal lesions compared to standard care. Real world registry data of this device has been under review.
Objective: To determine the safety of an esophageal temperature control device by an updated review of real-world registry data on its clinical use and any reported device-related adverse events.
Methods: The following databases were reviewed for any reported esophageal temperature control device-related complications: The United States Food and Drug Administration (FDA) Manufacturer and User Facility Device Experience (MAUDE), FDA Medical and Radiation Emitting Device Recalls, the Medicines and Healthcare products Regulatory Agency (MHRA) Medical Device Alerts and SwissMedic records of Field Safety Corrective Actions (FSCA). An internal registry (post-marketing follow up) database maintained by the manufacturer of the device was used to quantify the number used for each indication. Reported events underwent an updated review including any instances of device-related adverse events when used during catheter ablations.
Results: Of the **20,000** oesophageal temperature control devices used, **7120** were recorded as having been used for the purpose of esophageal protection during left atrial catheter ablations. A total of 5 events associated with the device were identified, all from the MAUDE database. Three were from 2017, one from 2018, and one from 2019. All involved its use in critical care or trauma patients and were related to user error or contraindicated patient selection; none resulted in serious harm to the patient. No adverse events occurred related to its use during left atrial catheter ablations. No case of clinically significant esophageal injury was reported in a patient who had been protected by the esophageal temperature control device.
Conclusion: Real world registry data has shown no adverse events reported to date in 7120 uses of an esophageal temperature control device during left atrial catheter ablations, for the purpose of active thermal protection.

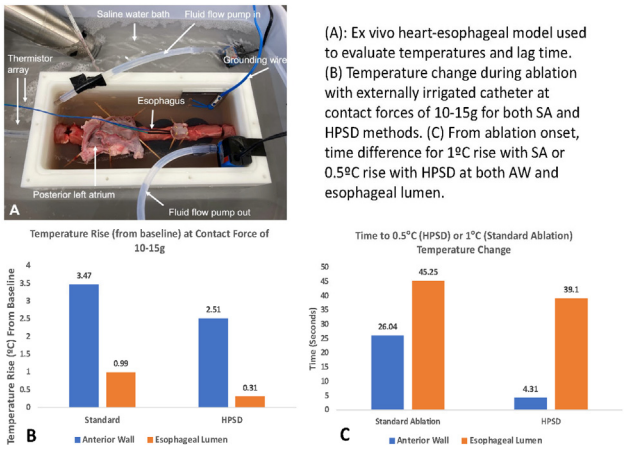
CA-528-04

ANTERIOR WALL TEMPERATURE OF ESOPHAGUS DURING CATHETER ABLATION OF THE LA POSTERIOR WALL IS MARKEDLY HIGHER COMPARED TO LUMINAL TEMPERATURE

Blair Holman; Christopher Barrett MD; Lukasz Cerbin MD; James Arthur Mann MD; Alexis Z. Tumolo MD; Matthew M. Zipse MD; Lohit Garg MBBS, MD; Johannes C. von Alvensleben MD, CEPS-P; Ryan G. Aleong MD, FHRS; Michael A. Rosenberg MD; Paul D. Varosy MD, FHRS; Wendy S. Tzou MD, FHRS and Amneet Sandhu MD

Background: Esophageal injuries (ulceration, denuding of tissue or fistula development) are well-known complications from catheter ablation. Few studies have evaluated energy transfer between the posterior wall of the left atrium (LA), interstitium and esophagus.
Objective: To study energy transfer and lag time between tissues, we developed a porcine *ex vivo* heart-esophageal model to evaluate temperatures at critical regions during catheter ablation of the posterior LA wall.
Methods: We built a heart-esophageal model to perform *ex vivo* catheter ablation on the posterior wall of the LA, with juxtaposed interstitial tissue and esophagus. Circulating saline (3.5-5 L/min) was used to mimic blood flow along the LA and alteration of ionic content to vary impedance. Thermistors along the region of interest were used to analyze temperature gradients. Varying time and power, multiple RF ablations were applied with an externally irrigated ablation catheter. Ablation strategies were divided into standard approaches (SA, 25-35W, 30s) or high-power short duration (HSPD, 40-50W, 10s).
Results: At contact forces ranging from 10-15g, for both SA and HSPD, maximum temperature rise from baseline was markedly higher at the anterior wall (AW) of the esophagus compared to the esophageal lumen (SA: 3.47°C vs. 0.98°C; HPSD: 2.51°C vs. 0.31°C). Compared to HPSD (Figure), SA approaches exhibited significantly higher temperature rise (relative to baseline) at both the AW (3.47°C vs. 2.51°C, $p<0.01$) and within the esophageal lumen (0.98°C vs. 0.31°C, $p<0.02$). For SA, time from ablation onset to a 1°C rise from baseline was 19.2 sec longer in the lumen relative to AW (45.25 sec vs. 26.04 sec, $p<0.05$). For HPSD, time from ablation onset to a 0.5°C rise from baseline was 34.8 sec longer in the esophageal lumen relative to AW (39.10 sec vs. 4.31 sec, $p<0.005$).
Conclusion: Compared to HSPD, SA exhibits significantly higher AW and esophageal lumen temperature rises. From baseline, rise in AW temperature is >2°C compared to the lumen with both approaches. Significant lag time exists between ablation onset and temperature rise measured at the AW and

esophageal lumen. With rapidly evolving ablation technologies, these data support further study to reduce inadvertent injury to juxtaposed tissue, improve safety, and enhance efficiency.



(A): Ex vivo heart-esophageal model used to evaluate temperatures and lag time. (B) Temperature change during ablation with externally irrigated catheter at contact forces of 10-15g for both SA and HPSD methods. (C) From ablation onset, time difference for 1ºC rise with SA or 0.5ºC rise with HPSD at both AW and esophageal lumen.

ABSTRACT CE-520:
Novel Arrhythmia Insights and Mapping Techniques

Friday, April 29, 2022
9:15 AM - 10:15 AM

CE-520-01

PULMONARY VEIN MYOCARDIAL SLEEVES ACT AS AMPLIFIER SITES DURING PERSISTENT ATRIAL FIBRILLATION: A HIGH DENSITY PHASE MAPPING STUDY

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Background: The mechanisms underlying persistent AF (PeAF) remain poorly defined. Although the substrate is not limited to the pulmonary veins (PVs), PV isolation (PVI) remains the best ablation strategy in PeAF.
Objective: To characterise the mechanisms of electrical activity originating in the PV sleeves during PeAF.
Methods: Eleven patients presenting for first time ablation for PeAF were recruited (63.1 ± 10.9 years, 91% males). Prior to PVI, a 64 electrode catheter (Constellation™; 38 mm) was introduced into the left atrium (LA) via trans septal access and positioned within the PV including the antral region under fluoroscopic guidance. A robust inverse mapping technique was used to reconstruct unipolar atrial EGMs on the PV surface and the resulting phase maps were used to identify incoming and outgoing wavefronts (WF) at the PV junction (reentry), and focal and rotor activity originating within the PV sleeves. These events were overlaid on phase entropy-time plots that reflect activation and repolarization heterogeneity across the PV surface. Data were analysed over 10 secs periods and are presented as median [LQ; UQ] or mean±SD, if normally distributed.
Results: During PeAF, the PVs gave rise to outgoing WF with frequency 3.7Hz [3.4; 5.4]. The most common mechanism generating outgoing WF was circuitous macroscopic reentry where an incoming WF generated one or more outgoing WF (frequency of reentry 2.7Hz [1.9; 3.3] compared with focal activity 1.4Hz [1.05; 1.5] ($p<0.001$). Rotors within the PV sleeve were rarely observed. Reentrant delay (time from wave-front entering to time of reentrant exit from the PV sleeve) was remarkably consistent between patients (125±46ms, range 30-260 ms, n=282). Higher outgoing frequencies were associated with repeated cycles of reentry (1 incoming wave generating 2 or more reentrant outgoing WF) and elevated phase entropy ($R^2 = 0.94$ and 0.93, respectively, $p<0.001$). The median ratio of incoming to outgoing PV activity was 1.14 (LQ=0.84, UQ=1.88). In 6/11 PVs (55%) the R was >1 (Mean 1.77±0.54, maximum 2.68).
Conclusion: Electrical activity generated by PV sleeves during PeAF is due mainly to macroscopic reentry initiated by incoming waves, frequently with a ratio>1. That is, the PVs act less as AF drivers than as “echo chambers” which sustain and amplify fibrillatory activity.

CE-520-02

ELECTRO-ANATOMIC REPOLARIZATION MAPPING WITH ORTHOGONAL BIPOLES AND MULTI-ELECTRODE ARRAYS: THE NEXT FRONTIER IN CATHETER TECHNOLOGY

Stephane Masse MASC, PE; Ahmed Niri BENG; John Asta; Mohammed Ali Azam; Patrick F.H. Lai MSci; Karl Magtibay BENG, MASC; D. Curtis Deno MD, PhD and Kumaraswamy Nanthakumar MD

Background: Sites of steep repolarization gradients have been attributed to arrhythmogenesis. However, identifying these regions during clinical mapping has not materialized. Activation interval recovery (ARI), monophasic action potential (MAP) and optical mapping are not practical for clinical usage during ablation procedure. Clinical repolarization mapping has not been practically viable largely due to instrumentation and signal processing challenges. We developed here a repolarization mapping technology from orthogonal bipole derived vector loops in multielectrode array and the time projection of the repolarization loop electrogram (loop derived repolarization-optimized egm, (rEGM), for assessment of repolarization on mapping arrays.
Objective: We hypothesised that rEGM provides vector derived integrated action potential duration (APD^V) that correlates with local repolarization assessed by optical mapping.
Methods: Simultaneous optical mapping and epicardial mapping with Abbott Advisor™ HD Grid was performed in 4 rabbit Langendorff experiments. Unipolar egms from 4 electrodes forming a square in the middle of the grid were recorded and intra-cardiac vectorcardiogram loops computed from orthogonal derived bipoles. rEGM was obtained by projecting the repolarization loop along its maximum axis. Epicardial waves propagating in different direction and pinacidil was added to alter APD. APD^V was measured from the onset of QRS to baseline return of rEGM. rEGM derived APD^V were compared with fluorescence signals and optical APD90 measured in the middle of the electrode clique.
Results: A total of 61 pairs of APD^V measurements were performed. Baseline conditions showed an VAPD average of 142ms versus APD90 of 151ms. After 20uM addition of pinacidil ARI and APD were reduced to 68ms and 89ms respectively. Linear correlation between APD^V and APD90 showed a R^2 of 0.7134 and a slope of 0.9540.
Conclusion: These results suggests that multi-electrode arrays with orthogonal bipoles could provide intra-electrode cardiac vector loops that enable local APD measurements for mapping utility. This concept ushers an era of using multi-electrode arrays to perform repolarization mapping and create 3D electro-anatomic repolarization maps to identify regions of steep repolarization gradients.